

**The Limidae of South Africa and Mozambique (Mollusca:  
Bivalvia): genera *Limaria*, *Limatula*, *Divarilima*, *Ctenoides* and  
*Fukama***

by

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**ABSTRACT**

New genus: *Fukama*, type species *F. messura* sp. n.

New species: *Limaria guttula*, *Limatula impendens*, *Limatula intercostulata*, *Fukama messura*.

New name: *Ctenoides barnardi* for *Lima divaricata* Barnard, 1964, non Dujardin, 1837.

New records for South Africa: West Atlantic origin: *Limaria loscombii* (Leach in Sowerby, 1823), *L. tuberculata* (Olivier, 1792). Indo-Pacific: *Limaria orientalis* (Adams & Reeve, 1859), *Limatula vermicola* Kilburn, 1975, *Ctenoides annulata* (Lamarck, 1819).

New combinations: *Lima abscisa* Barnard, 1964, to *Divarilima* Powell, 1958; *Lima symmetrica* Barnard, 1964, to *Ctenoides* Mørch, 1853; *Lima perfecta* E. A. Smith, 1904, to *Fukama* gen. n.

New synonyms: *Lima rotundata* Sowerby, 1843, and *Lima rufanensis* Turton, 1932 = *Limaria tuberculata* (Olivier, 1792); *Lima africana* Bartsch, 1915, and *Lima subventricosa* Turton, 1932 = *Limaria fragilis* (Gmelin, 1791).

New status: *Lima exigua*, *L. agulhasensis* and *L. densecostulata* Thiele, 1920, are valid species.

Type localities designated: *Limaria vulgaris* Link, 1807: Tranquebar, India.

Transferred to family Philobryidae: *Lima kowiensis* Turton, 1932.

**INTRODUCTION**

When Barnard's 1964 revision of the Southern African Limidae was published, only 8 species were reported from the region. Subsequently a considerable quantity of additional material has become available, mainly dredged during the NMDP. This, supported by study of type material in overseas museums, has permitted a fuller analysis than was previously possible. This paper brings the total number of known South African species to 22. One genus, *Limea* Bronn, 1831, has already been discussed by Kilburn (1990), and some notes on the commoner species of Limidae were published by Kilburn & Rippey (1982). In the present paper I deal with most of the remaining genera. The two species of *Lima* Bruguière, 1797, namely *L. lima vulgaris* (Link, 1807)<sup>1</sup> and *L. nimbifer* (Iredale, 1924), were briefly discussed by Kilburn & Rippey (see herein for *Lima perfecta* Smith, 1904).

<sup>1</sup>Oliver (1992: 83) has disputed my use of Link's name *vulgaris* for the Indo-Pacific subspecies of the Mediterranean-Atlantic *Lima lima lima* (Linnaeus, 1758), on the grounds that the authorities cited by Link (1807: 157) 'do not distinguish the forms'. However, one of these authors, Chemnitz (1784: 351), ascribes to it the locality Tranquebar, which is sufficient to fix the identity of *Limaria vulgaris* at the subspecies level. Tranquebar, SE India, is here formally designated as its type locality, and possible syntypes from that locality (B. Marshall, pers. comm.) are available in the Spengler collection (ZMUC) for future neotype designation.

It is relevant here to note that *Lima kowiensis* Turton (1932: 223, pl. 57, no 1553) is a member of the family Philobryidae, according to the two syntypes in OXUM (Figs 1–2). Their hinge is too worn for the species to be ascribed to a genus, but *kowiensis* is probably a valid taxon, which awaits rediscovery.

After completion of this manuscript, I received through the courtesy of Dr Rüdiger Bieler a copy of Stuardo's thesis on the taxonomy and systematics of the Limidae, submitted in 1968, but never published. In some cases Stuardo has anticipated (by 30 years) conclusions presented here. However, as his work will remain generally inaccessible, I have left my text largely intact.



Figs. 1–2. '*Philobrya*' *kowiensis* (Turton, 1932): syntypes of *Lima kowiensis*, OXUM colln. 1. RV exterior, 1.5 x 2.2 mm. 2. LV interior, 1.4 x 1.7 mm.

#### ABBREVIATIONS

h/l	=	ratio of shell height (umbo to ventral margin) to total shell length
d/l	=	ratio of <i>total</i> depth to length
AMSA	=	Australian Museum, Sydney
BMNH	=	The Natural History Museum, London
LV	=	left valve
MNHP	=	Museum National d'Histoire Naturelle, Paris
NMSA	=	Natal Museum, Pietermaritzburg
NMDP	=	Natal Museum Dredging Programme
OXUM	=	Oxford University Museum, Oxford
RV	=	right valve
R. K.	=	Richard Kilburn
SAMC	=	South African Museum, Cape Town
USNM	=	National Museum of Natural History, Washington D.C.
v	=	valve(s)
ZMHB	=	Zoologisches Museum, Humboldt University, Berlin

'Total depth' is a measurement of two valves united (or in the case of incomplete shells, that of a single valve doubled); 'valve depth' refers to that of a single valve. 'Greatest width' is used for that point at which the valve bulges most.

Accurate measurement of strongly oblique species such as *Limaria fragilis* is

difficult; measurements of shell height are taken along the vertical axis, perpendicular to the hinge-line, and shell length at a right angle to this axis.

Geographic subdivisions used in this paper are (west to east):

Namaqualand:	Orange River to St Helena Bay
Atlantic Cape:	St Helena Bay to Cape Point
False Bay:	Cape Point to Cape Hangklip
Overberg:	Cape Hangklip to Stilbaai
Tsitsikamma Coast:	Stilbaai to Cape St Francis
Eastern Cape:	Cape St Francis to Kei River
Western Transkei:	Kei River to Umtata River
Eastern Transkei:	Umtata River to Mtamvuna River
Southern Natal:	Mtamvuna River to Durban
Northern Natal:	Durban to Tugela River
Southern Zululand:	Tugela River to Leven Point
Northern Zululand:	Leven Point to Mozambique border

Agulhas Bank: Refers to the wide continental shelf between Cape Point and the Kei River, and is used mainly where the majority of records originate from deeper than approximately 50 m. Kilburn (1997) corrected some of the depth soundings for *Valdivia* stations on this shelf.

These geographic subdivisions should not be interpreted politically, e.g. the eastern Cape subregion (with a largely endemic temperate fauna) is *not* equivalent to the post-1994 Eastern Cape Province, which incorporates Transkei (a temperate/subtropical transitional region). Similarly 'Natal' is not equivalent to the province of KwaZulu-Natal, which includes the tropical faunal region of Zululand.

#### TAXONOMY

##### Family Limidae Rafinesque, 1815

##### *Limaria* Link, 1807

*Limaria* Link, 1807: 157. Type species (s.d. Winckworth 1930): *Limaria inflata* Link, 1807 [May] = *Lima inflata* Lamarck, 1807 [January] (*non Ostrea inflata* Gmelin, 1791) [= *Ostrea tuberculata* Olivi, 1792]

#### Notes

Bowden & Heppell (1966: 106, 120) and Vokes (1973: 91) have discussed some of the nomenclatural problems pertaining to the genus *Limaria* and its type species.

Although Morton (1979: 729) and various Japanese writers have differentiated at subgenus level the flatter-valved, more widely-gaping species of *Limaria* under the name *Platilimaria* Habe, 1977 (type species by o.d. *Lima hirasei* Pilsbry, 1901), the value of these characters is doubtful, as intermediate states appear to exist. An earlier name for this group is *Promantellum* Iredale, 1939 (type species by o.d. *P. parafragile* Iredale, 1939 = *Ostrea fragilis* Gmelin, 1791). Most authors differentiate species with little or no gape as *Limatulella* Sacco, 1898, although this is usually ranked as a subgenus of *Limea* Bronn, 1831, because the type species, *Lima loscombii* Leach in Sowerby, 1823, may 'occasionally show traces of tooth-like

structures on the hinge plate' (Bowden & Heppell 1966: 121). However, if a series of *Limaria* species (e.g. *fragilis-tuberculata-orientalis-loscombii*) are juxtaposed, degree of gape is seen to form a graded transition, and is probably a transformation sequence or more likely (correlated with escape movements) an adaptive homoplasy, and thus not phylogenetically significant. Stuardo (1968: 155–157, unpublished) accepted only *Limatulella* as a (doubtful) subgenus.

### Biogeography of *Limaria* in South Africa

I consider the South African marine molluscan fauna to have had three main origins: a tropical Atlantic one (represented almost entirely by peripheral isolates, the vast majority of which – the Bivalvia contains most of the exceptions – have evolved into Cape endemics), an Indo-Pacific one (consisting of both Recent incursives and subtropical/warm temperate isolates), and a small Southern Ocean element. The five South African *Limaria* species appear to encapsulate at least the first two of these origins.

Two of the three temperate-water Cape *Limaria* species consist respectively of a mainly littoral taxon that is indistinguishable from the European-West African *L. tuberculata* (Olivi, 1792), and an offshore Agulhas Bank element that proves referable to the West European-East Atlantic *L. loscombii* (Leach in Sowerby, 1823). It is probable that neither species could have continuously shared a gene pool with its ancestral population (neither of which presently ranges further south than Angola) since the late Pliocene or even earlier. At this time (Shannon 1985) allopatry would have been forced on such previously continuous populations by the development of the Benguela System, in which constantly lower temperatures and intermittent large-scale upwelling of cold water form a barrier or filter-route against continued southward dispersal along the Atlantic African coast. In the case of the coastal *L. tuberculata*, at least, it is probable that genetic continuity was temporarily restored during interglacial maxima and possibly even during deglaciation (see Pether 1994). In West Africa both species still live as far south as Angola, and the presence of *L. loscombii* in the Açores is indicative of its dispersal capacity.

Most of the remainder of the South African *Limaria* species have tropical Indian Ocean origins. The Indo-West Pacific *L. fragilis* (Gmelin, 1791) is an obvious representative of this element, having been distributed down the East coast littoral by the Agulhas Current during the Neogene or even earlier. During the last interglacial period (and no doubt also during earlier transgressions), it apparently established itself in the extensive lagoons and rias that were formed on the southern and eastern Cape coast (as indicated by its presence in Eemian raised beaches); as these drained and temperatures dropped, its range has retreated eastward, so that the main population is now to be found in KwaZulu-Natal, and its western limit appears to be defined by chance dispersal of the occasional veliger.

Another species of undoubted Indo-Pacific origin is *Limaria guttula* sp. n., as this is presently known only from the offshore coral reefs of Zululand, which define the true south-western limit of the tropical Indo-West Pacific region; however, it will probably be found to range further north into the Western Indian Ocean.

The occurrence of the taxon identified as *L. orientalis* (Adams & Reeve, 1850)

presents a more complex problem, as two apparently widely disjunct populations occur in South Africa. One – of which only a few (mostly juvenile) specimens are available – inhabits the same coral reefs as *L. guttula*, and is undoubtedly an Indo-Pacific incursive. The second population occurs considerably further south, in the Eastern Cape region and on the Agulhas Bank. Two possible origins can be suggested for the latter population. The most likely is that it is a tropical Indian Ocean relict, surviving from an earlier incursion, which has adapted to temperate water conditions. However, the same species occurs also in the temperate waters of south-eastern Australia and New Zealand, where its occurrence as early as the Oligocene was reported by Beu (1977). It is thus not impossible that this SE African population might prove to be an independently derived, Southern Ocean element.

#### Key to species of *Limaria* in South Africa and Mozambique

- 1 Posterior auricular sinus barely developed, underside of hinge with only a feeble pallio-cardinal pit on inner side of posterior ear; ribs internally forming rather deep radial grooves, externally with well-developed prickly nodules ..... ***guttula***
- Posterior auricular sinus distinctly concave, underside of hinge with a distinct pallio-cardinal pit or notch on posterior side; ribs forming only faint grooves internally, externally serrated but not nodulose.....2
- 2 Valves very shallow (d/h 0.27–0.38); internal margin adjacent to posterior gape thickened; intervals between main ribs with microscopic, diverging scratches visible in places ..... ***fragilis***
- Valves deeper (d/h over 0.41); internal margin adjacent to posterior gape without a supporting thickening; intervals without such microsculpture .....3
- 3 Posteroventral margin strongly oblique; valves shallowly compressed; d/h 0.41–0.53; gape slight; Agulhas Bank and western Transkei shelf ..... ***loscombii***
- Posteroventral margin rounded; valves less compressed; gape narrow to moderately wide .....4
- 4 Valves relatively shallow (d/h 0.42–0.54); gape relatively narrow; ribs with small scales ..... ***orientalis***
- Valves deep (d/h c. 0.53–0.70); gape wide; ribs with tubercles ..... ***tuberculata***

#### *Limaria tuberculata* (Olivi, 1792)

##### Figs 3–4

*Ostrea tuberculata* Olivi, 1792: 120 (cites Gualtieri, 1742: pl. 88, fig. FF, here designated as lectotype figure). Type locality: Northern Adriatic Gulf, Italy.

*Limaria tuberculata*; Salas, 1996: 58.

*Lima exilis* S. V. Wood, 1839: 234, pl. 3, fig. 1. Type locality: 'coralline crag, Ramsholt [upper Pliocene]. Red Crag, Walton, Essex' [early Pleistocene].

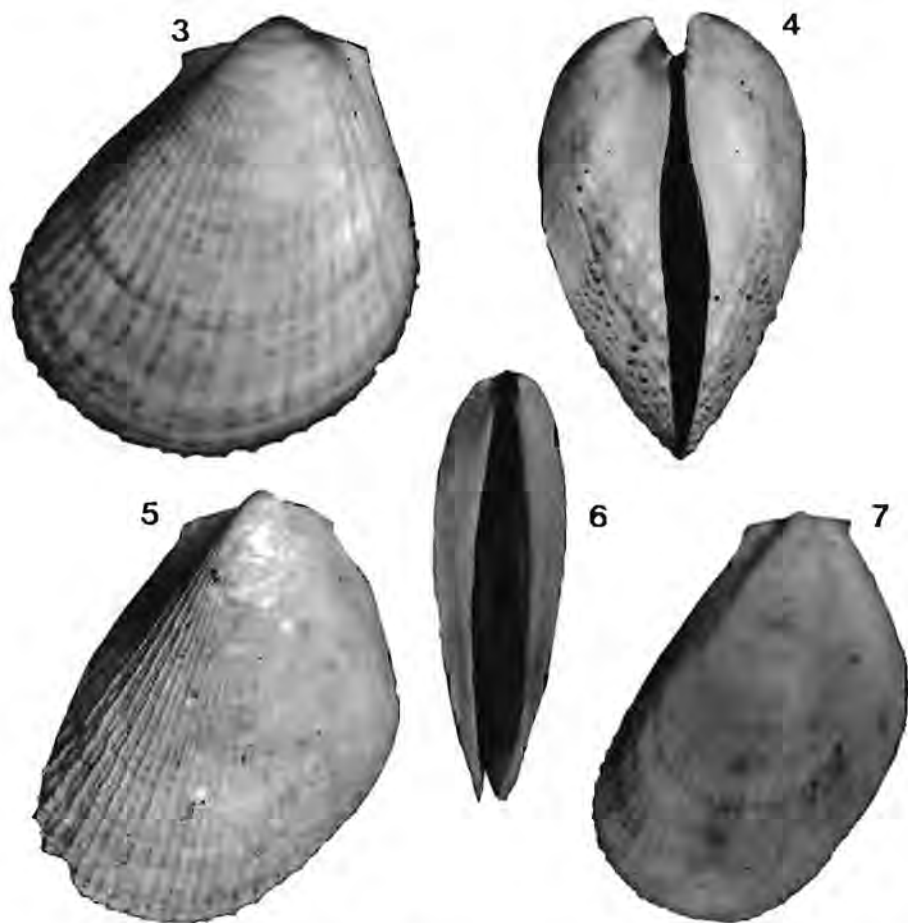
*Lima inflata* Lamarck, 1807 (non *Ostrea inflata* Gmelin, 1791): 463 (cites Chemnitz, 1784: 346, pl. 68 fig. 649a); Lamarck, 1819: 156. Type locality: not given [= 'l' Océan américain' f. Lamarck, 1819].

*Lima inflata*; Lamy, 1930: 174 (references), pl. 1, fig. 4 (Lamarck's syntype); Nicklès, 1955: 140 (references).

*Mantellum inflatum*; Lucas, 1980: 8, textfigs.

*Lima rotundata* Sowerby, 1843: 86, pl. 21, fig. 19; Sowerby in Reeve, 1872: pl. 1, sp. 5; Barnard, 1964: 436 (additional references), fig. 16a. **Syn. n.** Type locality: unknown.  
*Lima (Mantellum) rotundata*; Thiele, 1919: 27, pl. 4, fig. 8; Lamy, 1930: 179.  
*Limaria rotundata*; Kilburn & Rippey, 1982: 168, pl. 38, fig. 3, textfig. 130.  
*Lima rufanensis* Turton, 1932: 223, pl. 57, no 1559. **Syn. n.** Type locality: Port Alfred.  
*Lima angulata* (non Sowerby, 1843. *nec* von Münster, 1841); Thiele & Jaeckel, 1931: 166.

Type material: *O. tuberculata*: possibly still extant in Gualtieri's collection in the Museo di Storia Naturale e del territorio, Università di Pisa (Mrs Maria Fontana Angioy, *pers. comm.*). *L. inflata*: syntype in MNHP. *L. rotundata*: lost. *L. rufanensis*: holotype in OXUM.



Figs. 3-7. *Limaria* species. 3-4. *L. tuberculata* (Olivi, 1792): Swartkops estuary, Port Elizabeth, NMSA 8075, 29.3 x 32.9 mm, LV exterior and posterior views. 5. *L. orientalis* (Adams & Reeve, 1850): off Tsitsikamma, 113 m, NMSA V4634, 20.4 x 24.6 mm, LV. 6-7. *L. fragilis* (Gmelin, 1791): Durban, NMSA B1586, 20.2 x 26.0 mm, posterior view and LV exterior.

Distribution: Mediterranean and West Africa, south to Angola. South Africa: Saldanha Bay to Western Transkei (Dwesa), low tide to about 50 m; nestles under

rocks, in crevices in *Ecklonia* holdfasts or bryozoan colonies, or among *Pyura*, sometimes constructing a nest of byssus fibres.

South African locality records (all NMSA unless otherwise stated): **Atlantic Cape:** Saldanha Bay (Barnard 1964). **False Bay** (A3571, A3564: C. Connolly, living); Muizenberg, living (A1738, A3565, A3562: C. Connolly); Miller's Point (8086: C. Connolly); Glencairn, living (B1623: B. J. Young; A1746: C. Connolly); Fish Hoek, living (A1742: C. Connolly); 34°11.2'S, 18°35.8'E, 40 m, fine sand, worm-tubes (S3556: NMDP, live juv.); mid-entrance to False Bay, 54 m, fine sand (S9288: NMDP, juv.). **Overberg:** Struisbaai, beachdrift (E6606: E. Roscoe); off Cape Agulhas, Twelve Mile Bank, 26 m, *ex pisce* (V3470: D. Herbert); W of Stilbaai, 49 m, coarse sand and silt (V618: NMDP, 1 v); Stilbaai, beachdrift (A3563: C. Connolly); Witsand, St Sebastian Bay, beachdrift (E2387: C. Quickelberge, juv.). **Tsitsikamma Coast:** Knysna Lagoon, under rocks at LT (E5770: D. Brink). **Eastern Cape:** Jeffreys Bay, beachdrift (8715: E. K. Jordan); off Cape Recife, 25 m, in bryozoan colony (V135: B. Hayes); Algoa Bay (8754: H. C. Burnup, 3111: J. Crawford); Humewood, Port Elizabeth, living in swimming pool (8076: R. K.); Summerstrand, Port Elizabeth, rock pools at LST (8087: R.K.); Swartkops Estuary, under rocks and amongst *Pyura*, LST (8075: R.K.); off St Croix Is, 50–60 ft, dead (A6751: A. Connell); Port Alfred, beachdrift (D4655, B5587: J. Hutt; B7021: D. H. Kennelly; B7009: W. H. Turton, *ex Albany Mus.*, as *Lima africana* Bartsch, 1915); off Gonubie Point, 45 m, dead (B8485: NMDP). **Western Transkei:** E of Kei River, beachdrift (C3489: R. K.); Qolora River mouth (C8587: R. K.); Sandy Point (C3723: R. K.); Dwesa, beachdrift (C6104: R. K.).

Notes: The type locality of *Lima rotundata* was unknown, but Sowerby in Reeve (1872) gave its origin as 'Mediterranean'. The first authority to regard *L. rotundata* as South African was Krauss (1848: 29), who was followed by Thiele (1919), Lamy (1930), and subsequent writers on the region. However, I am unable to differentiate South African material from broader examples of the Mediterranean-tropical Atlantic species *Limaria tuberculata* (Olivi, 1792), which appears in the earlier literature (and some modern works) under the name *Lima inflata* (non Gmelin, 1791). Smith (1891: 393) had in fact long ago suggested that *rotundata* was a 'variety' of *L. inflata*. Stuardo (1968: 162, unpublished) regarded *L. inflata* and *L. rotundata* as 'definitely allopatric', but gave no justification for treating them as different species.

On the West African coast, *L. tuberculata* lives as far south as Angola (NMSA F8828 from Luanda harbour, F8543 from Moçamedes, and G4964 from Benguela). The Cape population appears now to be isolated from the Angolan one by a gap in its distribution along the Namibia-Namaqualand coast, caused by the cold Benguela Upwelling System. The only Atlantic Cape records are from Saldanha Bay, whose waters, as a consequence of solar warming, are a relatively constant 14–19°C (even higher in Langebaan Lagoon), compared with the more widely fluctuating 10–14°C of the open coast (Shannon & Stander 1977: 444). Records of *L. inflata* from the Red Sea are regarded by Oliver (1992: 84) as being based on the endemic *L. viali* (Lamy, 1919).

There has been some disagreement among European workers as to whether the

earliest applicable name is *Ostrea tuberculata* Olivi, 1792, or *Lima exilis* S. V. Wood, 1839. However, as was also concluded by Salas (1996), there appear to be no valid grounds for rejecting the earlier *O. tuberculata*, as the cited figure (Gualtieri 1742: pl. 88, fig. FF) is sufficiently diagnostic and the given locality fully in support. *O. tuberculata* was not discussed by Ghisotti (1978).

After examination of its holotype, I agree with Barnard (1964) that Turton's *Lima rufanensis* is based on an aberrant juvenile of *L. tuberculata*. However, the types of *L. subventricosa* Turton, 1932, and *L. africana* Bartsch, 1915, are juveniles of *Limaria fragilis* Gmelin, 1791.

### *Limaria fragilis* (Gmelin, 1791)

#### Figs 6–7

*Ostrea fragilis* Gmelin, 1791: 3332 (type figure Chemnitz, 1784: 349, pl. 68, fig. 650). Type locality: Nicobar Islands.

*Lima (Mantellum) fragilis*; Thiele, 1919: 34, pl. 1, fig. 2 (after Chemnitz, 1784), pl. 6, fig. 4; Lamy 1930: 169 (references and synonymy).

*Lima fragilis*; Prashad, 1932: 124 (references); Barnard, 1964: 438 (references); Takahashi, 1987: 7, figs.

*Limea (Promantellum) fragilis*; Oyama, 1943: 33, pl. 2, figs 7 a–b.

*Limea fragilis*; Willan, 1973: 15, fig. 3.

*Platilimaria fragilis*; Habe, 1977: 103.

*Limaria (Platilimaria) fragilis*; Morton 1979: 730 *et sequ.*, figs 2 B, 3 C (posterior view of animal), 4C, 6C, 7C (ciliary currents) [probably not fig. 1 c = ?*Limaria dentata* (Sowerby, 1843)].

*Limaria fragilis*; Kilburn & Rippey, 1982: 168; Oliver, 1992: 84, pl. 14, figs 7a–b, key figs 1 a–b.

*Lima africana* Bartsch, 1915: 187, pl. 38, fig. 4; Turton, 1932: 223. **Syn. n.** Type locality: Port Alfred.

*Promantellum parafragile* Iredale, 1939: 386, pl. 6, figs 10, 10a. Type locality: Low Isles, Queensland.

*Limaria parafragile*; Gilmour, 1990: 251, pl. 1, Fig. 1 (development and anatomy).

*Lima subventricosa* Turton, 1932: 223, pl. 57, no 1558. **Syn. n.** Type locality: Port Alfred.

*Lima hians* var. *tenera* (non Turton, 1825); Sowerby 1897: 28.

*Lima arcuata* (non Sowerby, 1843, nec Geinertz, 1837); Turton, 1932: 223.

Type material: *Ostrea fragilis*: holotype (basis for Chemnitz 1784: 349, pl. 68, fig. 650) originally in Spengler collection in ZMUC, but now no longer present (Mr T. Schiøtte, *pers. comm.*). *L. africana*: holotype valve USNM 249853. *L. subventricosa*: two odd syntype valves in OXUM, the larger being that illustrated by Turton; the latter measures 9.5 x 12.6 mm, valve depth 2.7 mm, which is slightly deeper (d/h 0.43) than in typical *L. fragilis*, but within its range.

Distribution: Indo-Pacific to KwaZulu-Natal, and as far south as East London (also occurs in Cape raised beaches dating from the Pleistocene); living from LST to 76 m.

Regional locality data (all NMSA: NMDP, loose valves, unless otherwise stated): **Northern Mozambique**: Nacala Bay, living (H4450: K. Grosch); Conducia Bay, living (H4451, H5528: K. Grosch); Conducia Bay, Choca, living, under encrusted rock, inshore (H4447: K. Grosch) and under rock amongst *Thalassodendron*, 1 ft above LST (H4449: K. Grosch). **Southern Mozambique**: Bazaruto Is., living (G2036: E. Roscoe); Santa Carolina Is., some living (F9653, J5090-1: E. Roscoe); Inhaca Is., living in crevices under coral in 1 m at LST (8095: R. K.), same locality, living and dead (8202-3: P. H. Boshoff). **Northern Zululand**: Off Kosi Bay, 45–47 m, red algae, sponges, living (D6271); SE of Kosi Bay, 50 m, coarse sand, shell (D6926) and fine sand, living (D6994); off Boteler Point, 66 m, sand, rocks (S3836)



and 93 m, sand (S9201); off Dog Point, 70 m, sandstone rocks (D6459) and 100 m, coarse sand (D7651); off Rocktail Bay, 100 m, sand (S5149); SE of Lala Nek, 84–97 m, coarse muddy sand (S7821); off Jesser Point, 68 m, sponge, coral rubble (D6943); NE of Liefeldt's Rocks, 50 m, lithothamnion, medium sand (E4312). **Southern Zululand:** SE of Port Durnford, 50 m, coarse sand (E4714) and 165 m, mud and sand (E8695); off Matigulu River mouth, 70 m, coarse sand (S755); off Glenton Reef, 50 m, shell bottom (S590). **Northern Natal:** off Sheffield Beach, 70 m, muddy sand (E9307); off Umhlanga Rocks, 45 m, coarse sand, sandstone, living (S390); SE of Sheffield Beach, 50 m, stones, shells (E3507) and sandy mud (E5084), and 50–55 m, sandy mud (E5157); Tongaat, littoral, living (8767: H. C. Burnup); off Umhlanga Rocks, 60 m (S351); Durban littoral, living (2408-9, 8756: H. C. Burnup; B1586: B. J. Young); off Durban Bluff, 18–20 m (B8978: R. K., D. Herbert); 6 km off Cooper Lighthouse, 76 m, living (A9769: C. S. I. R. Water Research). **Southern Natal:** off Umlaas Canal, 50 m, fine sand (D956, D1031); off Port Shepstone, 70 m, eroded shell, sponge (B3562); off Mbizane, 100 m, coarse sand, sponges (B9036); NE of Mtamvuna River, 50 m, fine sand (D4211). **Eastern Transkei:** Mbotyi (C8220: R. K., D. Herbert); off Port Grosvenor, 120–128 m, coarse sand (C1196); off Mzimhlava River, 50 m, gorgonians, soft coral (C526); off Mncwasa Point, 40–45 m, coarse sand (C2428). **Western Transkei:** Umtata River mouth, living (5190: R. K.); Qolora River mouth (C3442: R. K.). **Eastern Cape:** off Gonubie Point, 45 m, sandy mud, broken shell (B8484); off East London, 70 m, muddy sand (B8333); Port Alfred, beach (B5589: J. Hutt).

Late Pleistocene raised beaches (presumably last interglacial): Swartkops River mouth (5191: R. K.); Mossel Bay (8761: P. Elston).

Notes: Mr Tom Schiøtte has kindly loaned two specimens from the Spengler collection that were presumably part of the same series as the holotype. Both are smaller and more oblique than that figured, and have no type status. However, they are available for neotype designation, should a future reviser of the tropical Indo-Pacific *fragilis* complex consider this necessary. Stuardo (1968: 159, unpublished) regarded the south-east African population as a new species, which he described in MS, that was said to differ from *L. fragilis* in the presence of 'interradii'. Although intermediaries do appear to be more strongly developed in material from this region, they may also appear in individuals from the tropical Western Pacific, and I do not see grounds for recognition of a new species. Should a future reviser find support for Stuardo's conclusion, the earliest available name would be *Lima africana* Bartsch, 1915.

The identity of *Lima africana* has been disputed in the past. Its discoverer, Turton, claimed that it differed from *L. rotundata* [= *Limaria tuberculata*] in its finer ribbing and greater obliqueness, yet some if not all of the specimens distributed by him as *L. africana* to various museums are normal examples of *L. tuberculata*! This may explain Lamy's (1930) belief (based on material sent by Turton) that *africana* was very similar to *L. inflata* 'Chemnitz' [= *L. tuberculata*]. Presumably influenced by Turton's note, Barnard claimed that *africana* was based on an example of *L. rotundata* with more numerous ribs. Stuardo (1968: 161, pl. 9, fig. 42, unpublished) regarded *L. africana* as a valid species, evidently basing this on material of the

species here referred to *L. orientalis* (see below). However, I have compared the holotype valve of *L. africana* with juveniles of *L. fragilis* from Mozambique and Zululand, and can discern no differences. Specimens in the Turton collection (OXUM) labelled as *Lima africana* are neither *L. fragilis* nor *L. tuberculata* (see under *L. orientalis*).

*L. fragilis* varies somewhat in outline, and also in rib number, which increases with age by interpolation, but to varying degrees. Immature or less elongate individuals may even be mistaken for *L. orientalis*. The characteristic gape in *L. fragilis* begins to develop between a height of about 2.5 and 3.5 mm.

The original description of the shell of *Lima natans* Dufo (1840: 211) from the Seychelles is suggestive of *Limaria fragilis*, but Dufo's observation that the mantle was 'gris blanc' does not apply to that species.

While ensconced in a crevice the very long, deep red tentacles of *L. fragilis* effectively mimic those of an actinarian. Takahashi (1987) illustrated typical escape responses. In addition, when the bivalve is handled, its long tentacles are autotomised and continue to wriggle like worms; the mucus with which they are coated is extremely sticky, but apparently not acrid as reported (Gilmour 1967) for some limids (personal taste-test, Malaysia 1997).

The westernmost locality at which *Limaria fragilis* has been found living is Algoa Bay (F. Graeve, *pers. comm.*). The valve recorded from as far west as Stilbaai by Barnard (1964) may be assumed to have been washed out of a Pleistocene raised beach.

### *Limaria orientalis* (Adams & Reeve, 1850)

#### Fig. 5

*Lima orientalis* Adams & Reeve, 1850: 75, pl. 21, fig. 7. Type locality: Philippine Archipelago.

*Limaea* (*Promantellum*) *orientalis*; Oyama, 1943: 28, pl. 2, figs 4a–b.

*Limaria orientalis*; Willan, 1973: 15, fig. 1; Grange, 1974: 13, figs 1–5; Beu, 1977: 1, pl. 1; Cernohorsky, 1978: 180, pl. 64, fig. 5 (syntype), 5a; Powell, 1979: 383, pl. 73, fig. 10; Lamprell & Whitehead, 1992: pl. 17, no 97.

Distribution: Philippines and Japan to Zululand coral reefs (as far south as Sodwana Bay), 20–30 m, with an isolated population in the Eastern Cape and inner Agulhas Bank.

Type material: Although a syntype was illustrated by Cernohorsky (1978), this specimen could not be located in BMNH (1995, *pers. obs.*).

Regional locality data (all NMSA): **Southern Mozambique**: 0.5 mi. W of Santa Carolina Is., 3 fath., sand and shell debris (K2626: E. Roscoe, juvenile). **Northern Zululand**: between Bhanga Nek and Kosi Bay, 12–20 m, drop-off at outer edge of reef (D9489: D. Herbert, living, immature); off Sodwana Bay, 49–53 m, sand (S4720: NMDP, living juveniles); Sodwana Bay, sponge reef, 26–39 m (D5011: D. Herbert, 1 adult valve). **Eastern Cape** (all worn valves): Port Alfred, beach drift (V5447: J. Hutt; also Turton colln in OXUM, as *Lima africana*); Philipp's Reef, Algoa Bay, 11 m (S874: Mrs R. Cook); Kiwane, W of Kayser's Beach, beach drift (V4879: Carl Nauhaus). **Agulhas Bank**: Off Cape St Francis, 60 m, muddy sand with old shell

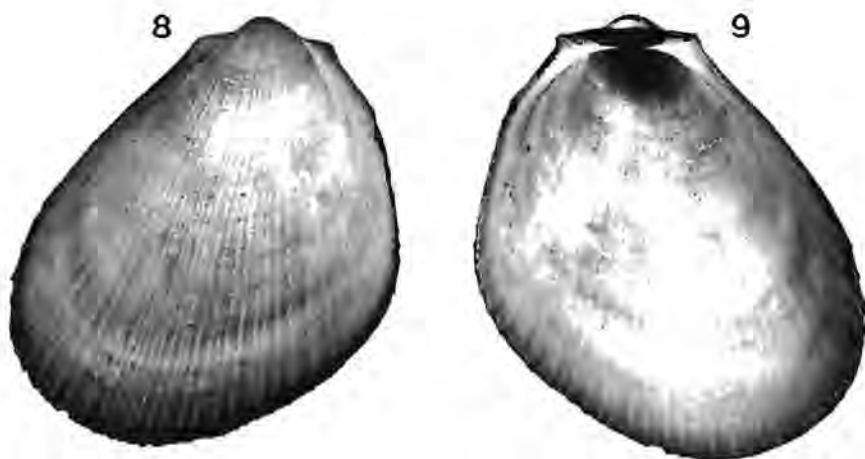
grit and pebbles (V4597); SE of Tsitsikamma area, 113 m, coarse sand and rock (V4634).

Notes: The species here tentatively referred to *Limaria orientalis* is superficially similar to *L. tuberculata*, but the valves are shallower (see key) and gape less. Also, radial ribs are more numerous in *L. orientalis* (usually in the order of 41–50, plus intermediaries), and weaken gradually towards each end, against 20–30 (and an occasional intermediary) plus 6–13 distinctly finer threads at each end in *L. tuberculata*. From *L. fragilis* it differs in being less compressed and less elongate, with a smaller gape, particularly anteriorly; the valve margins forming the posterior gape are not internally thickened as in that species.

Southern African specimens appear to agree satisfactorily with material from southern Australia and New Zealand identified by malacologists in those countries as *Limaria orientalis*. This species has been confused with the extremely similar *Limaria basilanica* (Adams & Reeve, 1850), and the relationship still remains to be finalised. Thus its Philippine type locality would imply *L. orientalis* to be a tropical element, yet Richard Willan (unpublished MS in AMSA) noted that in Australia *basilanica* appears to replace *orientalis* in warmer waters (southern Queensland northwards). The fullest statement of differences has been given by Willan (1973), but these are in practice not always obvious; thus main ribs in *orientalis* are variously given as 50–55 (Cernohorsky 1978), 40–50 (Willan 1973), 38–40 (Powell 1979) and 24 (Grange 1974). Although these counts are largely greater than those given for *L. basilanica* ('27–35'), they accommodate neither individual variation nor personal vicissitudes in deciding which are 'main' ribs, and which are secondary. Eastern Cape valves may have as few as 35 'main' ribs, or show such strengthened interstitials and development of lateral riblets that an objective count is impractical. Stuardo (1968: 161, unpublished) suggested that the name *orientalis* should be restricted to an elongated form with 28–32 ribs which inhabits the Philippines and adjacent areas. He regarded southern Australian records as being based on a new species with more numerous (35–41) ribs; however, if he is proved correct, the name *Promantellum vigens* Iredale, 1939, would presumably be available for such a taxon.

The holotype of *Limaria basilanica* (BMNH 74.12.11.394) is here illustrated (Figs 8–9); it is to some extent intermediate in sculpture between *orientalis* and *basilanica auctt.* The latter, as represented by NMSA material from Osima, Japan (F8156: Y. Hirase), Hamilton, Queensland (L4372: Mrs T. Whitehead) and Port Blair, Andaman Islands (F8132: Mrs E. Man) has somewhat stronger, more angular ribs with more regular fine intermediaries.

As a matter of record, Thiele (1919: 29) synonymised both *L. basilanica* and *L. orientalis* with *Lima (Mantellum) angulata* Sowerby, 1843 [*non* von Münster, 1841], which he regarded as cosmopolitan (however, the 11 mm valve from Algoa Bay which was recorded by Thiele & Jaeckel (1931: 8 (166)) under this name was more likely the common *L. tuberculata*). *L. angulata* is regarded by modern writers as a tropical West American species, for which the name *Limaria pacifica* (d'Orbigny, 1846) is used. Presumably unaware of the latter name, Lamy (1930: 180) renamed *L. angulata* as *Lima (Mantellum) orbignyi*, yet cited as a 'forme' *Lima basilanica*, with



Figs 8–9. *Limaria basilanica* (Adams & Reeve, 1850): holotype of *Lima basilanica*, BMNH 74.12.11.394, 22.3 x 23.8 mm, external and internal views respectively of LV.

*L. orientalis* as a synonym of the latter. Lamy (1930) would thus have to be followed as the first reviser, should future research confirm the latter two to be conspecific.

### *Limaria loscombii* (Leach in Sowerby, 1823)

Figs 10–13

*Lima loscombii* Leach in Sowerby, 1823: 113, fig. 4 (as *Lima loscombi* in caption to plate); Smith 1885: 291. Type locality: 'Devonshire' (United Kingdom).

*Lima* (*Limatulella*) *loscombei* [sic]; Lamy, 1930: 183 (references, synonymy); Lucas, 1980: 5, textfigs.

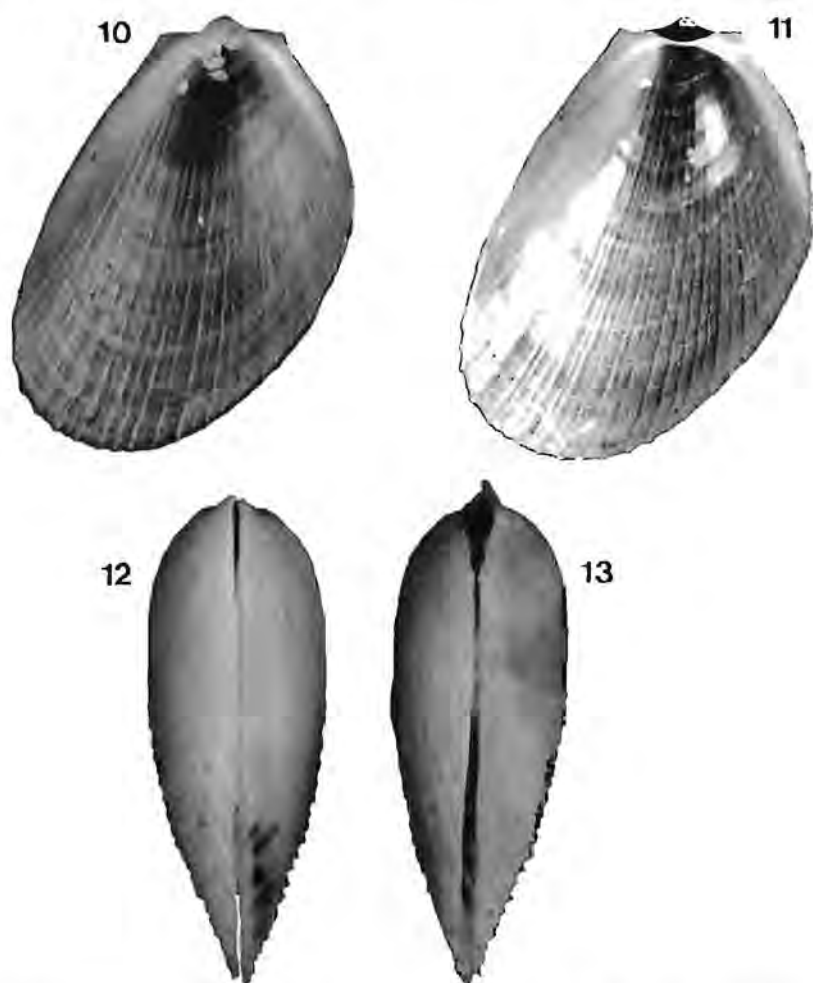
*Lima loscombi* [sic]; Tebble, 1966: 66, pl. 11c–m.

*Limea loscombii*; Bowden & Heppel, 1966: 107.

Diagnosis: Obliquely linguiform,  $l/h$  0.64–0.75, posterior margin strongly convex, anterior margin almost straight, byssal sinus slight; valves relatively shallow ( $d/h$  0.41–0.58), posterior gape very narrow, anterior one even narrower; posterior internal margin not thickened, resiliifer reaching umbo, its height *ca.* 0.36–0.48 of its length. Main radial ribs thin, sharp, *ca.* 22–35, very fine posteriorly, obsolete anteriorly, medially with intermediaries of varying strength; concentric striae fine, slightly serrulating radials, inner ventral margin finely denticulate; white. Maximum height 13.3 mm.

Description (based on regional examples): Thin-shelled, shape obliquely linguiform ( $l/h$  0.64–0.75), posteriorly strongly rounded, postero-ventrally strongly oblique, anterior margin almost straight; valves relatively shallow ( $d/h$  0.41–0.58); posterior (anal) gape very narrow and occupying less than 0.3 of posterior side, anterior (byssal) one even narrower; byssal sinus present but weak, posterior ear angular, very slightly hooked, anterior one bluntly angular. External ligament extending length of hinge margin, resiliifer reaching umbo, extending about half length of hinge line, elliptical ( $h/l$  0.36–0.48), external limit at beak, internal edge arching hinge-margin

ventrally; inner ventral edge of each side of cardinal area with a longitudinal pallio-cardinal pit deeper on posterior side.



Figs 10–13. *Limaria loscombii* (Leach in Sowerby, 1823): S of Cape St Blaize, 97 m, *ex pisce*. 10. LV exterior. 11. RV interior. 12. Anterior. 13. Posterior.

Radial sculpture of thin, sharp main ribs with weaker intermediaries; *ca.* 22–35 main ribs, which are low and well-spaced, becoming very fine posteriorly and obsolete anteriorly and on ears; median part of valve with intermediary riblets of different grades of weakness, all narrower than their intervals; external ribbing only faintly visible on inner surface of valve; fine, concentric striae are present throughout, becoming pliculate towards ventral margin and rendering radials slightly serrulate. Ventral margin rendered finely denticulate by rib terminations. Translucent white.

Dimensions: Height 9.5 mm, length 7.1 mm, depth 4.1 mm; largest valve 13.3 x 10.3 mm, depth 3.6 mm.

Distribution: Western Europe and eastern Atlantic, south to Angola and Tristan da Cunha; Agulhas Bank and western Transkei shelf (east to Sandy Point) in 60–100 m.

Regional material (all NMSA: NMDP): **Agulhas Bank:** S of Cape St Blaize, 97 m, *ex gut* of *Congiopodus torvus* (Gronovius, 1772) (V1161–2); SE of Tsitsikama, 115 m, coarse sand and shell gravel with small pebbles (V3510); SE of Knysna, 108 m, coarse shell gravel, rocks and bryozoa (V1467); SE of Plettenberg Bay, 171 m, coarse sand with little silt (V1070); off Storms River, 116 m, fine sand and gravel, a little silt (V1349); off Cape St Francis, 113 m, *ex pisce* (V4421); off East London, 70 m, grey sandy mud, schizaminid forams (B8356); same locality, 100 m, coarse sand, sponges (E7369); off Nahoon, East London, 85 m, medium sand, broken shell (B8403); off Bonza Bay, East London, 60 m, sandy mud (B8044). **Western Transkei:** off Sandy Point, 90 m, calcareous debris, coarse sand (C4545); off Qolora River, 80 m, coarse sand (C3955).

Notes: Comparison of Agulhas Bank examples with specimens of *Limaria loscombii*, kindly loaned by Dr Serge Gofas, from off Luanda (Angola), Ireland, France, Morocco and the Açores, reveals no differences. I have not attempted to cite more than a few of the numerous references to be found in the European literature, nor to trace the history of the various misspellings of the specific name ('*loscombei*' is an unjustified emendation, as Loscombe was not mentioned in the original text) or its various generic combinations.

Of southern African species, *L. loscombii* shows slight resemblance in form to the more tropical *Limaria fragilis*, but is much smaller, lacks its conspicuous gape, and has a distinctive outline. The two syntypes of *Lima subventricosa* Turton, 1932, show some resemblance to *L. loscombii*, but agree better in shape with immature *fragilis*.

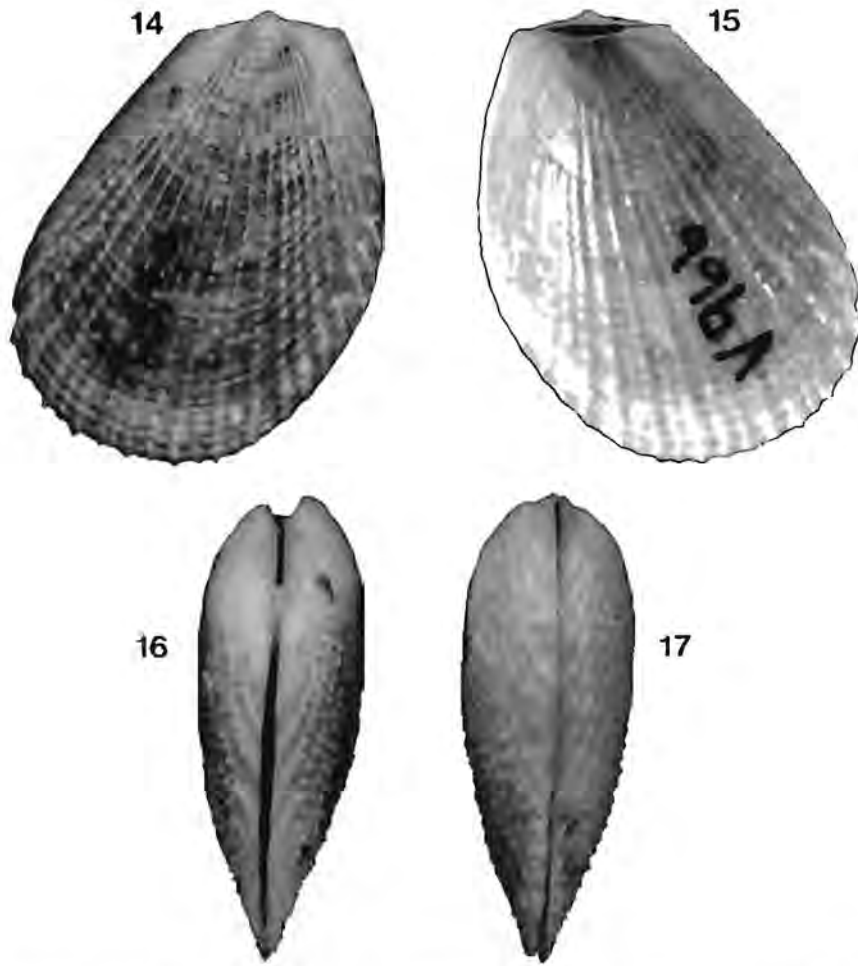
A single valve from off the Umlaas Canal, just south of Durban, in 250 m (NMSA D929: NMDP), resembles *L. loscombii* in shape but is more rounded and has closely-spaced radial ribs.

### ***Limaria guttula* sp. n.**

Figs 14–17

Diagnosis: Fragile, obliquely linguiform (l/h 0.73–0.79), byssal sinus absent; valves moderately shallow (d/h 0.39), gape very narrow; hinge thin, with only a faint notch on inner side of posterior ear; resilifer about half length of hinge, not reaching umbo. Radial ribs low, thin, 27–30 (with an occasional intermediary), bearing small, conical, vitreous nodules, anterior side and auricles smooth; fine growth lines and faint, microscopic, oblique scratches; interior with distinct radial grooves, forming rather weak crenae along margin; translucent white. Maximum height 16.6 mm.

Description: Shell thin, shape oblong-linguiform (l/h 0.73–0.79), moderately compressed (d/h 0.39), oblique; gape very narrow; auricles roundly angular, anterior one weaker and more obtuse than posterior, no byssal sinus; hinge narrow, rather flat, with only a faint groove-like pit on inner surface of posterior ear. External ligament extending length of hinge margin, resilifer low (h/l c. 0.21), not reaching umbo, extending about half length of hinge line, ventrally convex, slightly arching hinge margin.



Figs 14–17. *Limaria guttula* sp. n.: holotype, NMSA V966/T1331, Sodwana Bay, Northern Zululand, 17–18 m, 16.6 x 12.1 mm. 14. LV exterior. 15. LV interior. 16. Anterior. 17. Posterior.

Radial ribs low, thin, totalling 27–30, with an occasional weaker intermediary, bearing fairly small, conical nodules, slightly flattened transversely; anterior face of valve and both auricles smooth; externally also with fine, occasionally pliculate, growth lines, and very faint, microscopic, oblique scratches; intervals between ribs forming distinct radial grooves on interior of valve, margin rather weakly crenate. Translucent white.

Dimensions: length 12.1 mm, height 16.6 mm, total depth 6.4 mm (holotype); length 11.5 mm, height 14.6 mm, total depth 5.7 mm (paratype).

Type material: Holotype NMSA V966/T1331, Sodwana Bay, Zululand (27°32'S; 32°41'E), Seven Mile Reef in 17–18 m, under coral, don. Oceanographic Research Institute, Durban. Paratype, same data, NMSA E2279/T1332.

Notes: *Limaria guttula* is characterised by its unusually thin shell (as a result of which the ribs impress rather deep grooves internally), and by its very narrow gape, indistinct byssal notch, and relatively few (27–30), thin radial ribs, which are so low as to appear as little more than rows of prickles; the absence of a byssal sinus or even a slight concavity below the auricle is suggestive of members of the genus *Limatula*. *Limaria keokea* (Dall, Bartsch & Rehder, 1938) of Hawaii has a similarly shaped, equally thin shell, but differs in its hooked auricles and sculpture that is largely restricted to the posterior end. Stuardo (1968: 180, pl. 7, fig. 8, unpublished) illustrated and gave a MS name to a specimen from Mauritius which appears to be referable to *L. guttula*.

Etymology: *guttula* = a droplet (alluding to the vitreous appearance of the nodules), Latin.

#### *Limatula* S. V. Wood, 1839

*Limatula* S. V. Wood, 1839: 233. Type species (s.d. Gray 1847): *Pecten subauriculatus* Montagu, 1808.

Three species, *Lima agulhasensis*, *L. exigua* and *L. densecostata*, were described by Thiele (1920) from *Valdivia* dredgings on the central Agulhas Bank. His figures and descriptions were lacking in detail, misleading Barnard (1964) into synonymising all under one name. Barnard's action was queried by Fleming (1978), and also by Stuardo (1968: 195), who, however, observed that '*L. exigua* may be a synonym of *densecostata*'. Study of Thiele's type material confirms that these three species are not only valid but recognisable amongst the material collected during the NMDP. Kilburn (1975) added *Limatula vermicola* from the littoral of southern Mozambique, and two further species are here described.

I have followed Fleming (1978) in using the terms 'costellae' for the two differentiated median ribs, and 'sulcus' for the groove that separates them.

Although the distinction between *Limaria* and *Limatula* does not appear ever to have been queried, they are not always easy to distinguish in practice. Indeed, when a wide range of species is considered, it is difficult to find constant characters that are indicative of a true phyletic dichotomy. Under the conventional definitions (e.g. Cox & Hertlein in Moore 1969: 389; Stuardo 1968: 62), the shell in *Limaria* is widely gaping and strongly oblique, whereas *Limatula* does not gape, is smaller, oblong with deeper valves and has two well-differentiated costellae, separated by a sulcus, which shows internally. However, some apparent species of *Limaria* have only a narrow or indistinct gape, as do some members of *Limatula* (as redefined by Fleming 1978); some of the latter are also distinctly oblique or lack the costellae and sulcus, and there is even intergrading in valve depth and size between the two extremes. Other characters more often present in *Limaria* than in *Limatula* appear to be a distinct byssal sinus and a shallow to deep pit, for the attachment of the pallio-cardinal muscles, on the hinge plate adjacent to the posterior ear, beneath the actual hinge.

#### Key to species of *Limatula* in Southern Africa

- 1 Radial ribs coarse, extending to auricles, rendered angular by erect, close-set triangular nodules, each rib interval with 1–3 intermediary threads.....  
*intercostulata*



- Radial ribs fine .....2
- 2 Ribs few (8–12), restricted to median area, without distinct scales; ligament rarely wider than high, distinctly oblique .....*exigua*
- Radial ribs 20–39, usually extending almost to below auricles, with nodules or scales; ligament wider than high; barely oblique .....3
- 3 Ribs numerous (totalling > 60 at height 5 mm), their sides steep, usually continuing to auricles, and bearing transverse, nodose scales .....*densecostata*
- Ribs relatively few (<30 at height 5 mm), with sloping sides, usually obsolete below auricles, bearing scales which form conical nodules.....4
- 4 Not fragile; interior with median costellae well developed, greatest width at about mid-height; hinge line short, ventrally convex at resilifer; sinuses distinct.....5
- Fragile; internal costellae very faint; greatest width dorsal to mid-height; hinge line longer, straight; sinuses not developed .....*agulhasensis*
- 5 Hinge line projecting strongly beyond inner face of auricles; resilifer usually wider and lower (h/l usually 0.36–0.41); attains 18.5 mm in height; Agulhas Bank.....*impedens*
- Hinge line almost level with inner face of auricles; resilifer usually narrower and higher (h/l usually 0.52–0.57); maximum height 12.6 mm; Mozambique to Transkei shelf .....*vermicola*

Subgenus *Limatula* s.s.

*Limatula* (*Limatula*) *vermicola* Kilburn, 1975

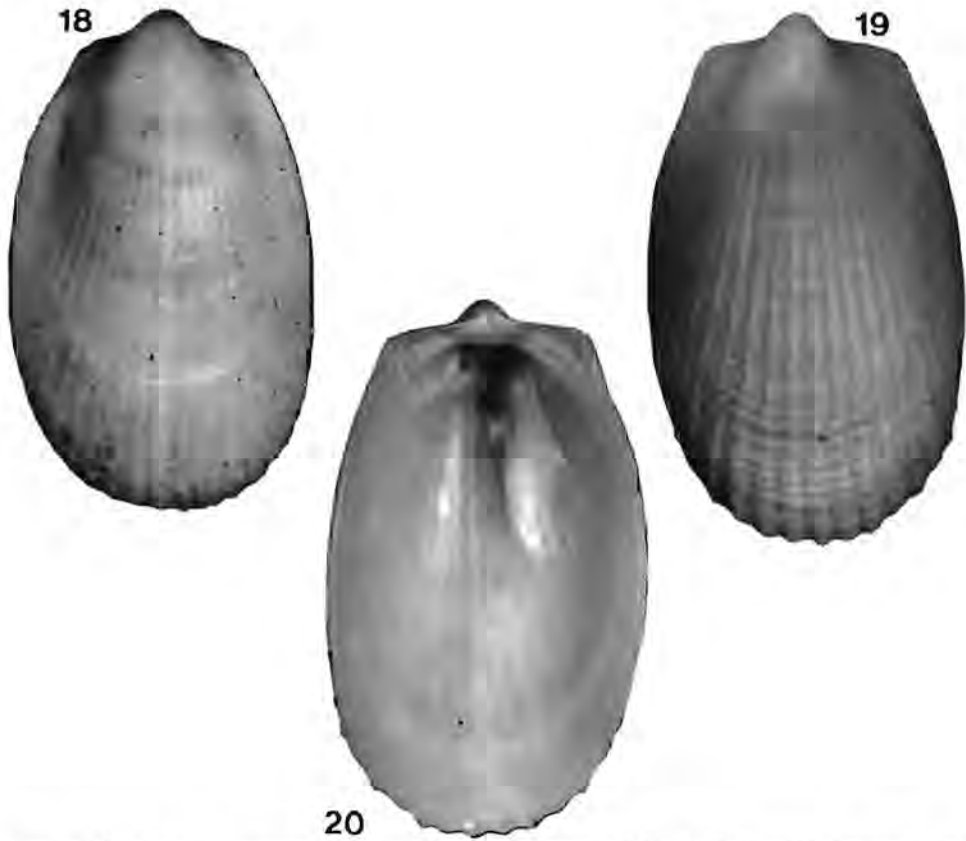
Figs 18–20, 24

*Limatula vermicola* Kilburn, 1975: 614, fig. 22. Type locality: sandbank between Santa Carolina Island and Mozambique mainland, LST.

*Limatula* (*Limatula*) *vermicola*; Fleming 1978: 32.

Diagnosis: Very slightly oblique, l/h 0.60–0.64, greatest width more or less median, valves deep (d/h 0.58–0.70), not gaping, hinge line relatively short, umbo moderately high, auricles rather angular, with slight posterior sinus. Resilifer reaching umbo, *ca.* 0.3 length of hinge line, its h/l usually 0.52–0.57 (rarely 0.40), rendering ventral edge of hinge-line convex; hinge line projecting only slightly beyond internal faces of auricles. Typically *ca.* 60 radial ribs, becoming finer towards sides, or becoming obsolete there in adults, leaving *ca.* 23–24 median ribs; costellae present or absent; ribs angular, equal to/narrower than intervals, with small angular nodules where crossed by concentric threads. Internally with a shallow sulcus, margin crenulated ventrally, smooth on sides. Maximum height 12.6 mm.

Notes: *L. vermicola* appears to be far more variable than the original material indicated. Thus, valves subsequently collected within a few kilometres of the type locality lack the strong external sulcus of the types (Fig. 18), although the corresponding costellae are visible internally. The sulcus is similarly feeble or absent externally in the numerous samples from South Africa (Figs 19–20). Externally, the fine lateral riblets present in Mozambique examples (presumed to be adult) are often



Figs 18–20. *Limatula vermicola* Kilburn, 1975. 18. Holotype, NMSA G2713/T1858, between Santa Carolina Is. and mainland, Mozambique, 4.1 x 6.6 mm, RV exterior. 19–20. NMSA D3745, SE of Umzimbazi River, Natal, 65 m, 5.9 x 9.7 mm, RV interior and exterior respectively.

developed only in similar-sized juveniles from further south, frequently (but not always) becoming obsolete in larger examples. Furthermore, in deeper water examples the external sculpture usually leaves additional radial impressions on the interior, unlike the types. Depth of the auricular sinuses also varies slightly between individuals. Although it is possible that a more intensive study would justify subspecies status for the South African population (there is no observable cline), a conservative approach is followed here. The species grows much larger in cooler waters and attains dimensions of 7.5 x 12.6 mm.

Fleming (1978) refers *L. vermicola* to the *Limatula* s.s. group of *L. tensa* (Iredale, 1939).

The numerous samples dredged by the NMDP (only a partial list is given below) have shown *L. vermicola* to be the commonest member of the genus off south-east Africa, and to be distributed as far south as the eastern fringe of the Agulhas Bank.

Distribution: Southern Mozambique to eastern Cape (off East London); in

Mozambique lives on sandbanks at LST amongst masses of fine, calcareous tube worms, but further south occurs mainly at a depth of 50–200 m, in rubble and on coarse sand; off Transkei often in even deeper water (200–510 m), although such specimens are seldom in fresh condition.

Type material: Holotype NMSA G2713/T1858; paratypes NMSA G2714/T1859, G2715/T1860, G2716/T1862.

Additional locality data (all NMSA: NMDP, loose valves, unless otherwise stated):

**Southern Mozambique:** Santa Carolina Is., Bazaruto Archipelago, south sandbanks (L186: R. K.). **Northern Zululand:** off Kosi Bay, 75 m, coral rubble, sandstone; off Boteler Point, 78 m, coarse sand (D7515); same locality, 58–61 m, sand, pebbles (S4178); same locality, 50 m, coral rubble (E5493); same locality, 67 m (S9714); off Dog Point, 76 m, sandstone rubble, gorgonians (S8988); same locality, 70 m, sandstone conglomerate, some alive (E1987); off Black Rock, 98 m, sand, stones (V314); off Gobey's Point, 120–150 m, sandstone rubble (D7580); NE of Liefeldt's Rocks, 50 m, medium sand, some stones (E3438); off Gipsey Hill, 65–70 m, broken shell (E7444); same locality, 100–125 m, broken shell (E3272); same locality, 84–90 m, sand (S7461); Leadsman Shoal, 100 m (B4798: A. Connell); off Leven Point, 250 m, coarse sand (S9283). **Southern Zululand:** SE of Mission Rocks, 100 m, medium sand (E3855); off Point Durnford, 75 m, coarse sand (D8085); off St Lucia, 50 m (A6168: CSIR bottom sample); off Matigulu River, 70 m, coarse sand, broken shell (S770). **Northern Natal:** off Glenton Reef, 200–210 m, sandy mud (S496); SE of Sheffield Beach, 100–105 m, glutinous grey mud (E5058); same locality, 50–55 m, sandy mud (E5155); off Ballito, 60 m, sandy mud (E5178); off Tongaat Bluff, 100 m, coarse sandy mud (E9781). **Southern Natal:** off Umlaas Canal, 100 m, muddy sand (D1074); same locality, 200 m, coarse sand (D875); off Amanzintoti, 300–305 m, medium sand (D1308); between Umgababa and Umzimbazi River, 70 m, fine sand (D3577); SE of Illovo Beach, 90 m, fine sand (D4108); SE of Umzimbazi River, 65 m, fine sand (E7374, D3745); off Park Rynie, sand, sponge (B3776); off Port Shepstone, 70 m, eroded shells, sponge (D3663); Shelly Beach, littoral (A4608: Mrs M. de Lanoy Meijer). **Eastern Transkei:** off Mgazi River, 180 m, soft mud (E93); off Port Grosvenor, 82 m, worm lithothamnial nodules (E757); same locality, 110–115 m, sand, some mud, solitary corals (C1344). **Western Transkei:** off Qora River mouth, 450–460 m, sandy mud (C6646); off Whale Rock, 430–450 m, fine muddy sand (C8885); same locality, 400 m, fine muddy sand (C9392); same locality, 250–280 m, sand and shell rubble (C8618); off Nthlonyane, 320–350 m, coarse sand (C9032); same locality, 345–400 m, fine sand (C9221); same locality, 80 m, sand, broken shell (C2585); off Nqabara Point, 330–340 m, muddy sand, broken coral, shells (C6452); off Shixini Point, 400 m, sand (C4448); same locality, 300 m, coarse sand, broken shell (C6368); off Mbashe River, 450–500 m, coarse sand, some mud (C9022); off Mendu Point, 250–260 m, coarse sand (C4940); off Stony Point, 360 m, coarse sand (C6826); same locality, 510 m, mud (C6946); off Sandy Point, 350 m, coarse sand, broken shell (C6786); off Qolora River, 340–350 m, coarse sand, broken shell (C6705); same locality, 290–300 m, fine muddy sand, broken shell (C6984); off Kei River, 222 m, coarse sand, old shell debris (C4081); same locality, 390 m, coarse sand (C3858); same locality, 138 m, coarse sand (C5136).



Figs 21–22. *Limatula impendens* sp. n., holotype, NMSA V973/T1533, S of Knysna, 210 m, 8.6 x 14.3 mm, RV exterior and interior respectively.

***Limatula (Limatula) impendens* sp. n.**

Figs 21–23

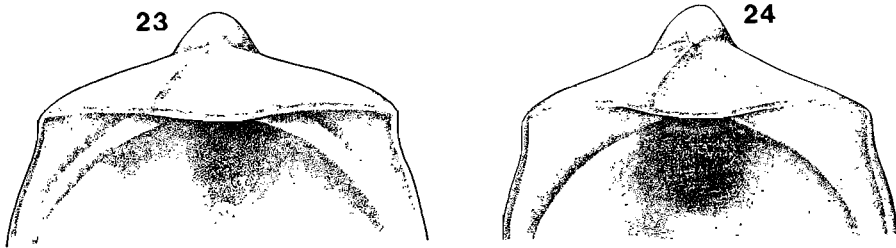
**Diagnosis:** Relatively large, slightly oblique,  $l/h$  0.60–0.69,  $d/h$  0.65–0.68, hinge line relatively narrow, greatest width approximately median, umbo moderately high, a slight posterior sinus. Resilifer with  $h/l$  0.36–0.41, occupying more than 0.3 of length of hinge line, and rendering its ventral edge convex; hinge line projecting strongly beyond plane of inner surface of auricles. Radial ribs 20–42 on median half, 0.2–0.5 width intervals, with weak conical nodules; sides of valves smooth or radially striate, costellae distinct internally and externally; intervals with microscopic concentric striae; inner margin crenulate ventrally, smooth on sides. Maximum height 18.5 mm.

**Description:** Shell oblong-ovate,  $l/h$  0.60–0.69,  $d/h$  0.65–0.68, slightly oblique; hinge line relatively narrow, maximum width approximately median, umbo strongly peaked, ventral margin slightly flattened; posterior auricle slightly more angular than anterior, with a slight sinus below; evidently no gape. Hinge plate deep and declivous; resilifer with height/length 0.36–0.41, occupying more than 0.3 of length of hinge line, and rendering its ventral edge convex; hinge line projecting strongly beyond the plane of inner surface of auricles; underside of hinge plate buttressed by a ridge, which forms a small groove-like pit, on either side. Sculptured by about 20–30 thin radial ribs (occasionally as many as 42), occupying median half of valve, becoming weaker abmedially, sides of valve smooth or with fine radial striae; ribs thin, angular, 0.2–0.5 width intervals; medially with two distinct costellae. Surface crossed by microscopic concentric striae and coarser ones that form weak, conical nodules. Interior with two distinct costellae, inner ventral margin crenulated, smooth on sides; posterior adductor muscle scar relatively large. White.

Dimensions: Holotype: height 14.3 mm, length 8.6 mm, valve depth 4.8 mm. Largest paratype (damaged): height 18.5 mm, length 11.9 mm.

Distribution: Outer Agulhas Bank from Knysna to Cape St Francis, known only from dead valves in 210 m.

Type material: Holotype NMSA V973/T1533, S of Knysna (35°00'S; 22°59'E), 210 m, medium-fine sand with old shell rubble, 1 RV. Paratypes, NMSA V5740/T1536, same data, 2 LV; V5633/T1535, SW of Cape St Francis, 210 m, coarse sand and shell debris, 2 LV, 2 RV. All NMDP.



Figs 23–24. Hinge plates. 23. *Limatula impendens* sp. n. 24. *L. vermicola* Kilburn, 1975. Not to scale.

Notes: This species, by far the largest South African *Limatula*, is known only from odd valves, dredged at two Agulhas Bank stations. Nevertheless, it is clearly distinct from its nearest ally, the south-east African *Limatula vermicola* Kilburn, 1975, from which it probably evolved as a peripheral isolate. Apart from its much larger size, *L. impendens* differs from *L. vermicola* in its overhanging hinge line (Figs 23–24); in *vermicola* the inner face of the auricles is nearly level with the hinge line and lacks the shallow notch on each side. In juvenile *L. impendens* the characteristic hinge characters are not as well developed, but such individuals may still be distinguished from *vermicola* by their more strongly crenulate inner ventral margin and an outline that is broader dorsally. Additionally, the two species may usually be distinguished by the proportions of the resilifer; in *L. impendens* this tends to be relatively wider and lower than in most individuals of *L. vermicola*, in which the resilifer typically resembles an equilateral triangle.

Etymology: *impendens*, present participle of Latin *impendeo*, overhanging (referring to the projecting hinge line).

### *Limatula (Limatula) exigua* (Thiele, 1920)

Figs 25–30

*Lima (Limatula) exigua* Thiele, 1920: 48, pl. 9, fig. 13; Thiele & Jaeckel, 1931:10 (168). Given type localities: Agulhas Bank: off Quoin Point (34°51.0'S; 193°07.8'E), '80 m' [= 60–70 m] [type locality here restricted], and SE of Cape Agulhas (35°26.8'S; 20°56.2'E), depth not given [= ca. 70–80 m].

*Limatula (Limatula) exigua*; Fleming 1978: 22.

Diagnosis: Small and thin-shelled, l/h 0.60–0.67, distinctly oblique, maximum width more or less median, not gaping, umbo low, d/h 0.55–0.65, auricles weak, declivous,

sinuses slight. Resilifer narrowly triangular, less than 0.33 of length of hinge line. Radial ribs weak, 8–12, crenulating fine, dense concentric threads, ribs sometimes appearing as opaque, white rays; costellae faint externally, stronger internally, inner margin crenulate ventrally only. Maximum height 4.9 mm.



Figs 25–26. *Limatula exigua* (Thiele, 1920), lectotype of *Lima exigua*, ZMHB, off Quoin Point, 60–70 m, 2.4 x 4.0 mm, RV exterior and interior respectively.

Description: Shell small and thin, distinctly oblique, ovate-oblong, sometimes narrowly so ( $l/h$  0.60–0.67), with maximum width more or less at mid-height, umbo low; no gape,  $d/h$  0.55–0.65, ventral margin strongly but asymmetrically convex; auricles weak, obtuse, declivous, posterior one slightly the stronger; posterior auricular sinus slight, anterior one slight to obsolete. Radial ribs weak, restricted to median part of surface, low, rounded, wider than intervals or equal to them; 8–12 in number, costellae very slightly to distinctly stronger than adjacent ribs, becoming finer and more widely spaced anteriorly, absent below auricles; very fine, crinkled, concentric threads overall, with periodic stronger ones, which may form slight, flattened imbrications on ribs. Interior with feeble to distinct costellae, in the latter case often with traces of additional 1–2 riblets on either side, terminating in weak to fairly strong crenules. Resilifer narrowly triangular, less than 0.33 length of hinge line, its  $h/l$  0.67–0.83, its ventral edge weakly convex to straight. Greyish-white, slightly translucent.

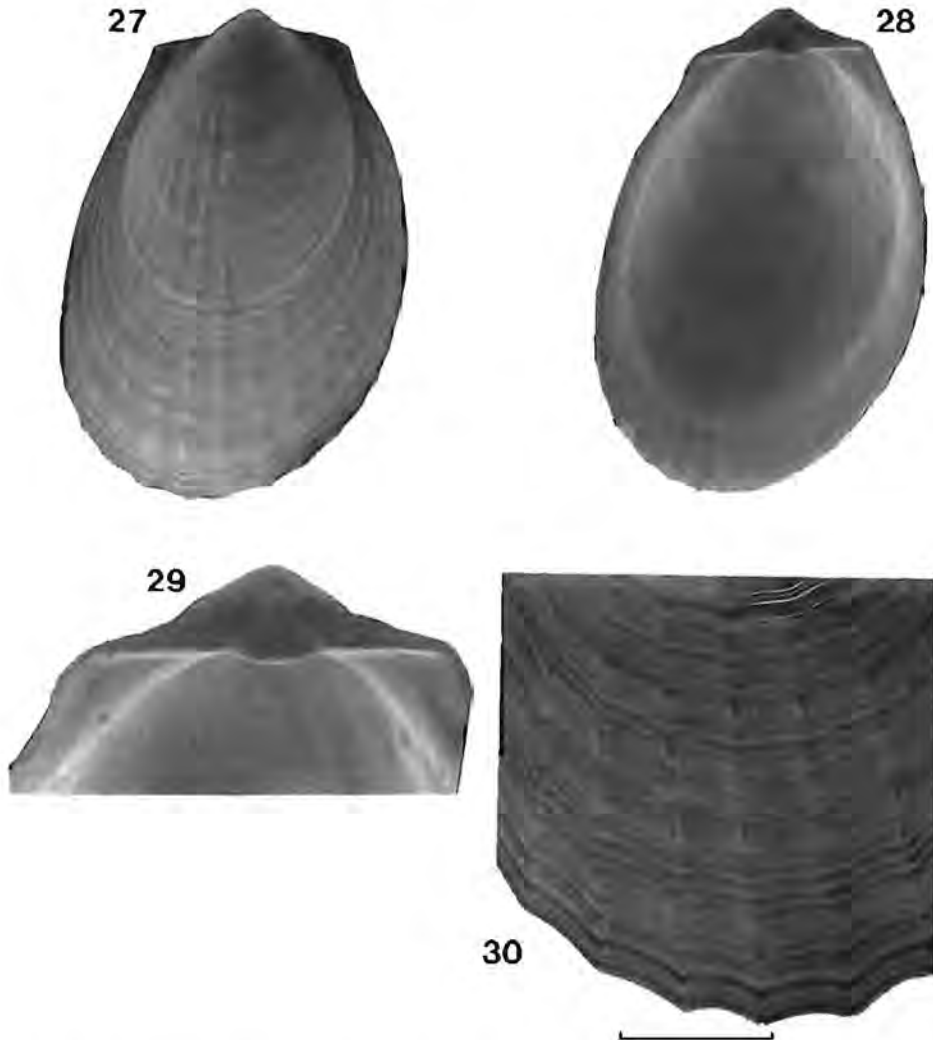
Dimensions: Maximum height 4.9 mm, length 3.2 mm, valve depth 1.4 mm.

Distribution: Transkei Shelf (off Ubombo) to Agulhas Bank and Cape Agulhas region (Struisbaai), mainly in 32–80 m, but single valves occurring down to 400 m and even littorally.

Type material: Four syntype valves in ZMHB from *Valdivia* stns 106 and 95; the largest (stn 106) measuring 2.4 x 4.0 mm, valve depth 1.3 mm, is here designated lectotype (Figs 25–26).

Additional material (all NMSA: NMDP unless otherwise stated): **Eastern Transkei:**

off Ubombo, 135–165 m, sponge rubble (E7554, V317); same locality, 60–62 m, coarse sand, conglomerate (E306, E142); off Whale Rock, 70–73 m, marine growths, calcareous debris (E743). **Western Transkei:** off Nthlonyane, 51 m, sandy mud, corals (E105, E1093); off Stony Point, 390–400 m, muddy sand, small stones (E7); off Qolora River, 80 m, coarse sand (V316). **Agulhas Bank:** off Cape Recife, 52 fath. [= 95 m] (SAMC A9921: *Pieter Faure*); off Tsitsikamma River, 210 m, sand and old shell grit (V1595). **Tsitsikamma Coast:** Gericke Point, Sedgefield, Knysna, beach drift (S5905: J. P. Marais, numerous valves). **Overberg:** off Struisbaai (34°45.1'S: 20°09.5'E), 32 m, sponges, stones (S7691).



Figs 27–30. *Limatula exigua* (Thiele, 1920), NMSA E105, off Nthlonyane, Transkei, 51 m, 2.2 x 3.0 mm, SEM. 27–28. LV exterior, RV interior. 29. RV hinge. 30. Sculpture magnified (scale-bar = 0.48 mm).

Notes: *Limatula exigua* is a temperate water endemic, distinguished from other South African species by its greater obliqueness and weak sculpture. In the types and in other specimens from the western part of its range, the internal median ridges are retained only near the margin, but in the eastern members of the population they are usually distinct throughout.

Littoral samples have been found only at Gericke Point, but their large number and uniformly somewhat small size (none exceeding 2.4 mm in height.), implies that this is a local population, rather than merely the consequence of a particular upwelling event.

*Limatula (Limatula) agulhasensis* (Thiele, 1920)

Figs 31–34

*Lima (Limatula) agulhasensis* Thiele, 1920: 48, pl. 9, fig. 12; Thiele & Jaeckel, 1931: 9 (169). Type locality: S of Mossel Bay (35°16.0'S 22°26.7'E), 155 m.

*Limatula* ['s.lat.'] *agulhasensis*, Fleming, 1978: 19.

Diagnosis: Fragile, l/h 0.69–0.75, d/h 0.46–0.55, slightly oblique, greatest width at or slightly dorsal to midline, umbo low, dorsal line nearly straight; auricles not hooked, dorsal line relatively wide; radial ribs 21–48, low and thin, finer on sides of valves, obsolete immediately below auricles, crossed by concentric threads, forming prickly, conical scales, two median costellae weak but visible internally, terminate on inner ventral margin as crenules, absent laterally; resilifer small. Maximum height 6.9 mm.



Figs 31–32. *Limatula agulhasensis* (Thiele, 1925), lectotype, *Lima agulhasensis*, ZMHB, S of Mossel Bay, 155 m, 5.0 x 6.9 mm, RV exterior and interior respectively.

Description: Shell fragile, slightly oblique, oblong-ovate, l/h 0.69–0.75, greatest width at about mid-height to about 0.3 from dorsal margin; d/h 0.46–0.55, valves without gape; umbo low, auricles weak, obtuse, not declivous, posterior auricular sinus shallow, anterior one not developed. Sculptured by 21–48 low, roundedly angular ribs, equal to/markedly narrower than their intervals, visible in places more



by their scales than their elevation; costellae and their sulcus distinct, on sides of valves ribs become progressively finer and more widely spaced, obsolete immediately below auricles. Concentric sculpture of thin, widely spaced, slightly lamellate ridges, some stronger than others; where cross radials form small, erect, concentrically compressed, acutely trigonal nodules or scales. Interior with weak radial ridges, costellae distinct, rather flat-topped, terminating on ventral edge in flattened crenules, lateral margins smooth inside, with weak crenules developing towards median; non-porcellaneous edge rather wide. Resilifer relatively small, occupying *ca.* 0.2 length of hinge, usually wider than high but *h/l* 0.29–0.50, ventral edge straight or slightly convex. Translucent white.

Dimensions: Length 5.0 mm, height 6.9 mm, valve depth 1.6 mm (largest example).

Distribution: Central Agulhas Bank and Transkei Shelf (east to Waterfall Bluff), in about 150–500 m, on substratum of sand or rubble.

Type material: Two syntype valves from *Valdivia* stn. 104 in ZMHB; the larger (3.6 x 5.1 mm) here designated lectotype (Figs 31–32).

Additional locality data (all NMSA: NMDP, single valves unless otherwise stated):

**Eastern Transkei:** off Waterfall Bluff, 400–550 m, pebbles, fine sand (C9805); off Whale Rock, 150–200 m, sponge rubble (E63). **Western Transkei:** off Nihlonyane, 550 m, sand, stones, broken *Dendrophyllia* (C8686); off Shixini Point, 500 m, muddy sand, coral rubble (E7434); off Qora River, 300 m, coarse sand, some broken shell (C6743); same locality, 400–420 m, coarse, slightly muddy sand (E7437); off Sandy Point, 450–498 m, fine sand, stones (C4122); off Qolora River, 440–446 m, fine sand, with *Dendrophyllia* (C4068); off Kei River, 490–500 m, sandy mud, *Dendrophyllia* (C6926).



Figs 33–34. *Limatula agulhasensis* (Thiele, 1925). 33. NMSA C9805, off Waterfall Bluff, Transkei, 400–500 m, 4.7 x 6.4 mm, LV. 34. NMSA C4122, off Sandy Point, Transkei, 450–498 m, 3.0 x 4.0 mm, LV.

Notes: Few specimens are available, the species being not only rare but so fragile that all examples examined under SEM fractured during the process. The number and spacing of radial ribs appears to be variable, ribs being sometimes equal to the intervals, in other individuals less than half their width; both extremes may occur in the same sample. Sometimes the ribs are so low as to be visible in places more by their scales than their elevation. *L. agulhasensis* is similar to *L. densecostata* in shape, but adults are more ovate (l/h 0.69–0.75 against 0.62–0.68 in *L. densecostata*), and the latter species has more closely set, steeper-sided radial ribs, which strongly serrulate the ventral margin and bear dense, blunt scales. *L. densecostata* also differs in the more convex ventral edge to its ligament pit and in its barely oblique outline.

Transkei material appears to agree with the types, although it is mainly from deeper water.

*Limatula (Limatula) densecostata* (Thiele, 1920)

Figs 35–39

*Lima (Limatula) densecostata* Thiele, 1920: 49, pl. 9, fig. 14; Thiele & Jaeckel, 1931: 9 (167). Type locality: S of Mossel Bay (35°16.0'S; 22°26.7'E), 155 m.

*Limatula* ['s.lat.'] *densecostata*; Fleming, 1978: 22.

Diagnosis: Valves very slightly oblique, rather oblong (l/h 0.62–0.68), juveniles more ovate, umbo relatively low, d/h 0.56–0.69; hinge line ventrally convex at resilifer, which is usually longer than high; radial ribs 65–90, steep-sided, serrulating ventral margin, bearing transverse nodule-like scales; costellae present but not strong, lateral ribs becoming fine and dense towards auricles; interior with weak radial ribs and distinct costellae. Length 12.4 mm.

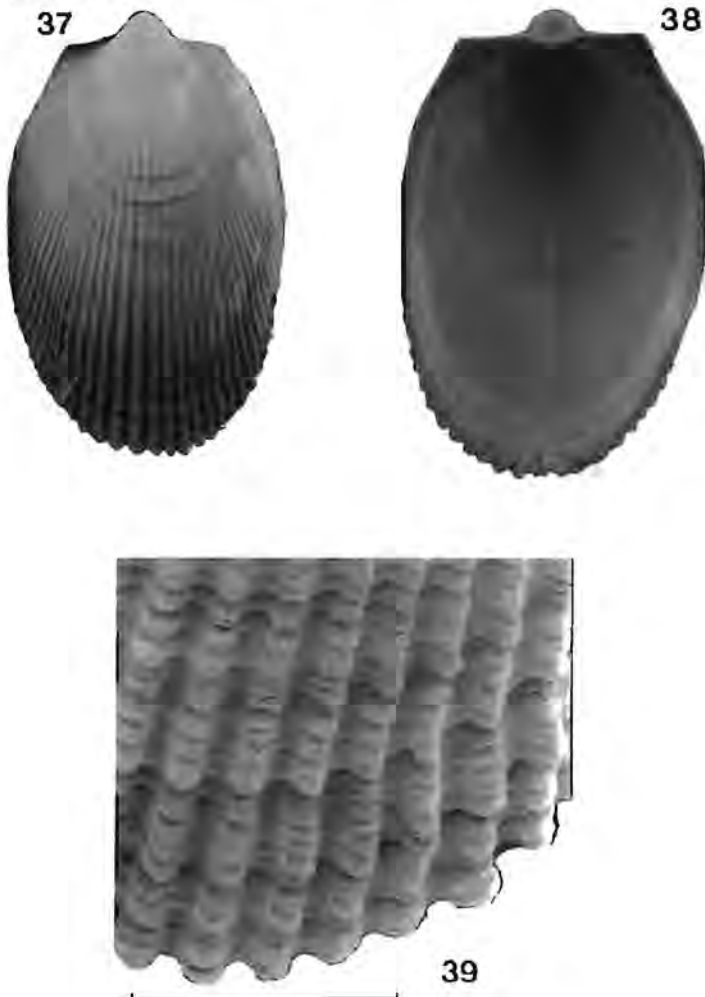


Figs 35–36. *Limatula densecostata* (Thiele, 1925), lectotype, *Lima densecostata*, ZMHB, S of Mossel Bay, 155 m, 3.1 x 4.8 mm, RV exterior and interior respectively.

Description: Shell thin, very slightly oblique, ovate-oblong, adults relatively narrowly so, l/h 0.62–0.68, greatest width dorsal to mid-height; valves without gape; umbo

relatively low, auricles weak, obtuse, not declivous, posterior auricular sinus very slight, not developed anteriorly. Radial ribs narrow, 65–90, narrower to wider than their intervals, medially relatively high and steep-sided, costellae and sulcus present but not strongly differentiated, ribs on sides of valves finer and closer, continuing to auricles; bear close-set scales, typically arched into transverse nodules; concentric threads of uneven strength, distinct in rib intervals. Interior with weak radial ridges, costellae slightly stronger than rest and terminating in flattened crenules, entire ventral margin strongly serrulated by rib terminations, lateral margins smooth inside. Resilifer usually longer than high, but its h/l varies from 0.36–0.60, at ventral edge of hinge plate convex; hinge plate with a slight notch on either side at hinge line/auricular junction. White.

Dimensions: Length 7.9 mm, height 12.4 mm, valve depth 4.3 mm (largest example measured).



Figs 37–39. *Lamatula densecostata* (Thiele, 1925), NMSA E109, off Qolora River, Transkei, 80 m, 3.6 x 5.9 mm. SEM. 37. RV exterior. 38. LV interior. 39. Sculpture (scale-bar = 0.40 mm).

Type material: Five syntype valves from *Valdivia* stn ZMHB, two broken, the largest (height 4.8 mm, length 3.1 mm, valve depth 1.3 mm) is here designated lectotype (Figs 35–36).

Distribution: Agulhas Bank and Transkei Shelf, from off Cape St Blaize to Port Grosvenor, mainly in *ca.* 70–210 m, but fresh valves also in 400–500 m.

Additional locality data (all NMSA: NMDP unless otherwise stated): **Eastern Transkei:** off Port Grosvenor, 80–84 m, calcareous coral nodules, sand (E134); off Umgazi, 180 m, soft mud (E7538); off Ubombo, 96 m, sand and gravel (E7553); off Whale Rock, 70–73 m, calcareous debris (V318); same locality, 500 m, fine sandy mud (C9241); same locality, 90 m, sponge rubble, small pebbles (E7566); off Mncwasa, 74 m, sand and rubble (E1070). **Western Transkei:** off Sandy Point, 51 fath. (SAMC 9919); off Qolora River, 80 m, coarse sand (E109). **Agulhas Bank:** off East London, 100 m, coarse sand, sponge (E7366); off Algoa Bay, 52 fath. (SAMC 9921); S of Cape Recife, 360–400 m, clean shell grit, with shallower derived debris (V2239); SW of Cape St Francis, 210 m, coarse sand with shell debris (V5634); off Storms River, 117 m, silted sand, some shell grit (V1322); SE of Plettenberg Bay, 171 m, coarse sand, little silt (V1071); SSE of Knysna, 101 m, living bryozoan corals, sand and shell gravel (V1021, living); SE of Tsitsikamma, 115 m, sand and shell gravel (V3511) and 172 m, *ex pisce* (V5345); off Cape St Blaize, 125 fath. [= 229 m] (SAMC A9920); SSE of Cape St Blaize, 114 m, from gut of *Congiopodus torvus* (V970).

Notes: *Limatula densecostata* is not uncommon, but is known mainly from loose valves. The largest examples were dredged in 400–500 m.

#### Subgenus *Limatuletta* Fleming, 1978

*Limatuletta* Fleming, 1978: 73. Type species (o.d.): *Limatula japonica* A. Adams, 1863.

Diagnosis: Distinguished by its 'squat form, lack of sinuses and strong evenly distributed sculpture' (Fleming 1978).

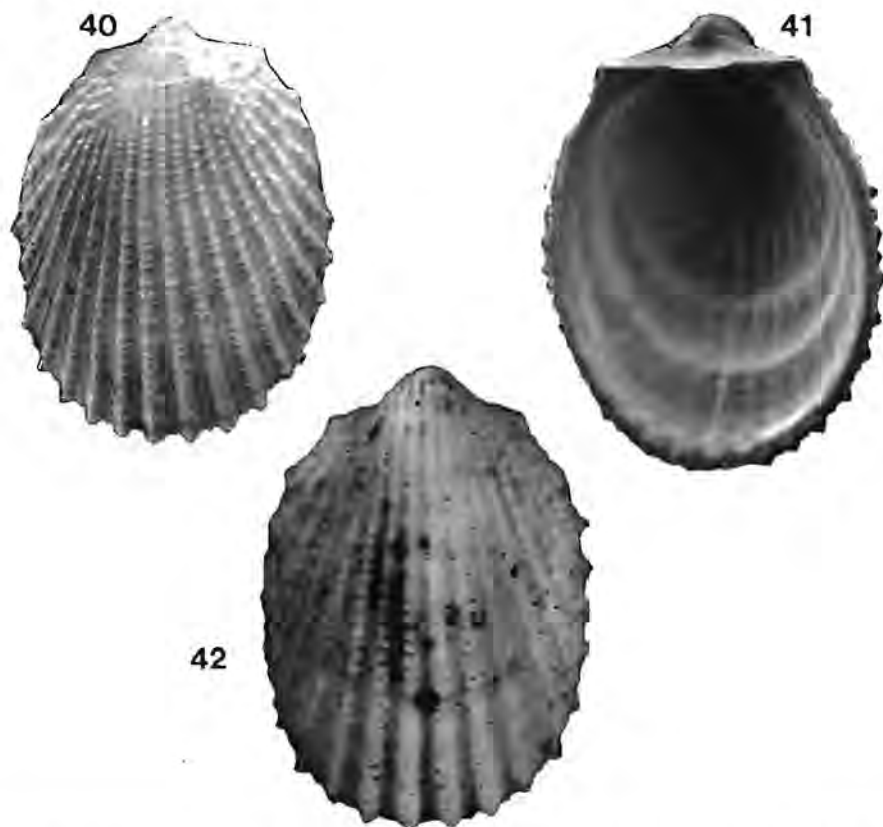
#### ***Limatula (Limatuletta) intercostulata* sp. n.**

Figs 40–44

Diagnosis: Outline oblong-oval with evenly curved sides, l/h 0.70–0.83, valves fairly deep (d/h 0.61–0.72), auricles weakly differentiated, hinge line relatively short; radial ribs prominent, angular and coarse, continuing strongly to auricles, 20–27, bearing erect, triangular, sharp nodules, each interval with a fine thread; grooves on median third of interior distinct, not forming costellae. Maximum height 7.5 mm.

Description: Shell oblong-ovate, very slightly oblique, l/h 0.70–0.83, greatest width at mid-height or slightly dorsal to this, ventral margin strongly convex; valves fairly deep (d/h 0.61–0.72); auricles small, obtuse, usually declivous, auricular sinuses very shallow; resilifer with h/l 0.46–0.53, its ventral margin convex. Sculptured by strong radial ribs, keeled by series of erect, triangular, concentrically compressed nodules, ribs continuing to auricles, on sides of valves with coarse nodules (occasionally reduced to low, well spaced, compressed ones); ribs strongest medially, there usually equal to/wider than intervals, on sides of valve narrower than them; 20–27 ribs.

Interval between each pair of ribs with median thread (sometimes 2–3). Concentric threads strong, particularly on sides of valve, dorsal margin somewhat squamose. Interior with radial ribs (produced by impressions of external rib intervals), strongest medially (but without differentiated costellae), terminating in blunt marginal denticles. White.



Figs 40–42. *Limatula intercostulata* sp. n. 40–41. Paratypes (SEM), NMSA S4946/T1252, off Black Rock, Northern Zululand, 98 m. 40. RV exterior, 4.3 x 5.9 mm. 41. LV interior, 4.4 x 6.0 mm. 42. Holotype, NMSA B3622/T1248, off Leadsman Shoal, 100 m, 4.3 x 5.2 mm. LV exterior.

Dimensions: Length 4.3 mm, height 5.2 mm, total depth 3.2 mm (holotype); 4.8 x 7.5 mm, valve depth 2.4 mm (largest paratype).

Distribution: Zululand (Boteler Point) to Transkei (off Stony Point), living in 80–100 m (dead valves to 250 m), but in deeper water off Transkei (390–400 m, valves to 460 m).

Type material (all NMSA: NMDP unless otherwise stated): Holotype B3622/T1248, Leadsman Shoal, Northern Zululand (ca. 27°47'S; 32°39'E), 100 m, live, A. Connell.

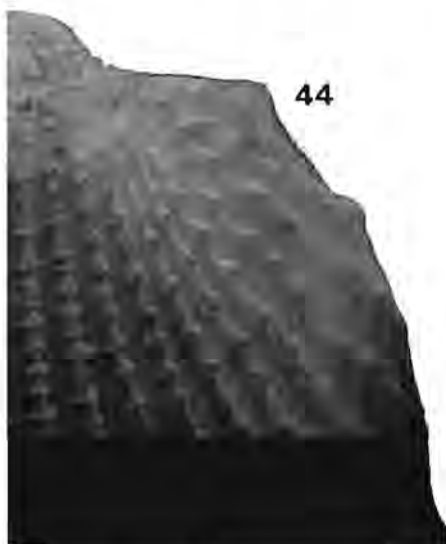
Paratypes: **Northern Zululand:** S9198/T1250, off Boteler Point, 93 m, sand, 3v; D6414/T1249, same locality, 70 m, coral rubble, 1v; D7687/T1261, off Dog Point, 250 m, medium sand, 2v; D7668/T1253, same locality, 150 m, coarse sand, 5v;

S4946/T1252, off Black Rock, 98 m, sand, stones, 13v; D7621/T1263, off Rocktail Bay, 100 m, sandstone rubble, 2v; S4588/T1262, off Gipsev Hill, 70–80 m, sand and rocks, 1 living (LV damaged); D6451/T1259, off Jesser Point, 200 m, fine sand, 1v; A5816/T1260, off Sodwana Bay, *ex* CSIR bottom sample, 9v; E4862/T1251, NE of Leven Point, 105 m, sandstone rubble, old shells, 3v; S9337/T1255, same locality, 250 m, coarse sand, 16v; E3854/T1256. **Southern Zululand:** SE of Mission Rocks, 100 m, medium sand, 1v. **Southern Natal:** D1150/T1254, off Umlaas Canal, 150 m, muddy sand and fine pebbles, 1v; D1112/T1257, same locality, 250 m, coarse sand, 1v. **Eastern Transkei:** C2060/T1258, off Whale Rock, 400–420 m, coarse sand, old shell debris, 1v; C6859/T1267. **Western Transkei:** off Qora River, 400–420 m, coarse, slightly muddy sand, 3v; C6645/T1265, same locality, 450–460 m, sandy mud, 1v; E6/T1266, off Stony Point, 390–400 m, muddy sand, small stones, 2 juv., 2v; C6789/T1264, same locality, 1 juv., 1v.

43



44



Figs 43–44. *Limatula intercostulata* sp. n., sculpture of paratype, NMSA S4946/T1252 (see fig 40), SEM, scale-bars = 0.60 and 0.96 mm respectively.

Notes: Fleming (1978) regarded *Limatula japonica* A. Adams, 1863, as a polytypic species, comprised of 5 subspecies in the western Pacific and western Australia. The present taxon conforms closely in general characters to this complex, and extends the known range of the complex into the south-western Indian Ocean. However, I prefer to accord it full species status. Morphologically, the most similar taxon to *L. intercostulata* is *L. japonica spinulosa* Fleming, 1978, which is restricted to a small area north of New Zealand; *spinulosa* has less prominent radial ribs, generally more numerous (mean number 26, against 22 in *intercostulata*) and lacks interstitial radials. Externally, *L. intercostulata* shows a close but superficial resemblance to *Limea drivasi* Kilburn, 1990, but that species is much smaller and has characteristic hinge plicae.

In juveniles of *L. intercostulata*, sometimes in individuals as high as 3.8 mm, the radial ribs are uniform in strength, bear prickly scales, and their intervals lack interstitial radials. An aberrant adult specimen of 4.03 x 5.36 mm, from off Boteler Point in 50 m (NMSA D7730), possesses ribs that lack the keel-like series of scales and has unusually wide intervals, each with a strong intermediary riblet.

Etymology: *inter* (between) + *costatus* (ribbed), Latin adjective, referring to the interstitial ribbing.

### *Divarilima* Powell, 1958

*Divarilima* Powell, 1958: 72. Type species (o.d.): *Lima sydneyensis* Hedley, 1904.

Notes: The genus *Divarilima* was introduced for an Australasian species described as 'a miniature *Lima* with a *Ctenoides* sculptural pattern of divaricating threads' (Powell 1958). It has been well defined by Cox & Hertlein (1969: 389), and has been discussed in some detail by Stuardo (1968: 120 on, unpublished). Globally, the genus appears to be represented by only 4 other described species, namely *Acesta iwaotakii* Habe, 1961 and *Divarilima elegans* Hayami & Kase, 1993, of Japan, *Lima albicoma* Dall, 1886, from the tropical western Atlantic, and *Lima abscisa* Barnard, 1964, from South Africa. Stuardo (1968) described two further species in MS.

### *Divarilima abscisa* (Barnard, 1964), **comb. n.**

Figs 45–47

*Lima abscisa* Barnard, 1964: 441, fig. 16f; Giles & Gosliner, 1983: 45. Type locality: off Cape Morgan, east of East London, Cape Province, 47 fath. [= 86 m].

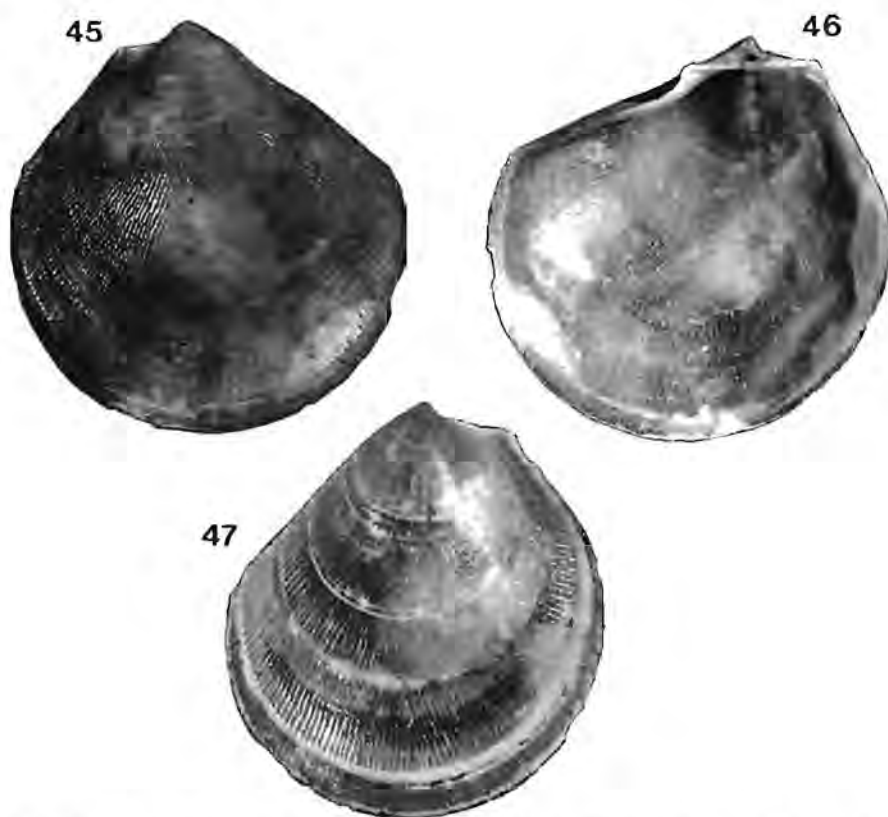
Distribution: South-eastern Africa, from northern Natal to eastern limit of Agulhas Bank, living in 70–240 m on a bottom of rubble and sponges.

Type material: Syntypes SAMC A9504, 3 valves; two of these were figured by Stuardo (1968: pl. 5, figs 6–7, unpublished).

Additional locality data (all NMSA: NMDP, loose valves, unless otherwise stated): **Northern Natal:** off Tugela River, 80 fath. [= 146 m] (Barnard 1964). **Southern Natal:** off Park Rynie, 120 m, rubble and solitary corals, living (B3794), same locality, 110 m, sponge-rubble, in alcohol (E7691); off Port Shepstone, 70 m, eroded shells, sponge, living (B3570). **Eastern Transkei:** off Mtamvuna River, 143 m, sponge-rubble (C903), same locality, 120–140 m, sponge-rubble (E76); off Mbotyi, 200 m, sandstone slabs, coarse sand (C9756); off Port Grosvenor, 95–100 m, coarse sand (E7417); off Ubombo, 60–62 m, coarse sand, oyster shell conglomerate (E310, E144, E7551); off Whale Rock, 150–165 m, coarse sand, corals (E107). **Western Transkei:** off Nthlonyane River, 300 m, medium sand (C8698); off Shixini Point, 240 m, sponge-rubble, some sandstone, in alcohol (E7690); off Mbashe River, 100 m, sponges (C9363); same locality, 74 m, calcareous nodules (E52); off Qora River, 400 m, sand (C4908). **Agulhas Bank:** off East London, 100 m, coarse sand, sponges (E7368).

Notes: No sign of a byssus has been observed in the few dry examples dredged alive. The tentacles are relatively short (actual length variable in preserved material), very slender and colourless. The largest valve examined measures 6.5 x 6.5 mm. The





Figs 45–47. *Divarilima abscisa* (Barnard, 1964). 45–46. NMSA E7328, off Mtamvuna River, 150 m, 5.5 x 5.6 mm, RV exterior and interior. 47. NMSA C8698, off Nthlonyane, 300 m, 5.4 x 5.6 mm, RV exterior.

valves from 300 and 400 m, listed above, have probably washed to that depth from shallower water.

Barnard compared *D. abscisa* with the Australasian *Divarilima sydneyensis* (Hedley, 1904), from which it differs markedly in shape. There is far greater resemblance to *D. iwaotakii* (Habe, 1961) from Japan. Comparison of specimens of *abscisa* with the holotype valve of *Acesta iwaotakii* (NSMT 39928, kindly loaned by Dr A. Matsukuma) reveals no constant difference other than sculpture; in *abscisa* this is distinctly finer and diverges more strongly below the umbonal ridge. Although it is not impossible that the two taxa merely represent the extreme ends of an Indo-Pacific cline, the warm temperate to subtropical range of *abscisa* indicates that it is not a true Indo-West Pacific element.

A second species of *Divarilima* is represented by a few specimens from more tropical waters (Figs 48–49). I have examined two valves from northern Zululand (NMSA S6465, off Dog Point, 74 m, sandstone rubble, gorgonians; NMSA S5184, off Rocktail Bay, 100 m, sand) and two from Réunion Island (NMSA K5713, off Cap la Houssaye, 12 m, J. Drivas). These are not referable to *D. abscisa* and agree far





Figs 48–49. *Divarilima* sp. aff. *D. sydneyensis* (Hedley, 1904), NMSA S6465, off Dog Point, Zululand, 74 m, 6.9 x 9.0 mm, exterior and interior of RV.

better with *D. sydneyensis* (Hedley, 1904) in their more elongate shape and concave anterodorsal margin. Although they lack the brown colour and widely spaced concentric ridges of that species, these are variable characters in *D. abscisa*. In the absence of intermediate records, or indeed any from the tropical Indo-Pacific (recorded range New South Wales to northern New Zealand), I prefer not to positively identify these as *D. sydneyensis*. More material in better condition is required.

#### **Fukama** gen. n.

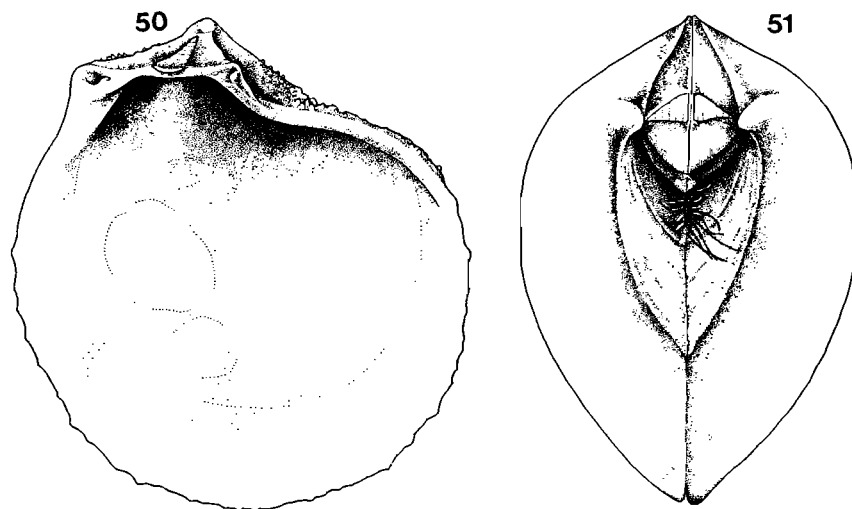
Type species: *Fukama messura* sp. n.

Diagnosis: Shell relatively small (maximum dimensions <15 mm), length nearly equal to height; strongly tumid, anterior and posterior gape very slight to the merest crack, outline trigonally orbicular, very inequilateral, umbo angular, slightly prosogyrate, divergent; antero-dorsal margin with a large lunule-like concavity, deforming dorsal line, bordered by an umbonal ridge; auricles small, anterior one the more projecting. Hinge line short, very asymmetrical, its ventral edge rendered convex by the resilium, each end of hinge plate with a single nodule-like denticle fitting into an opposing socket; resilium trigonal, much narrower than deep, crossing the wide cardinal area obliquely. Sculptured by coarse, close radial ribs with scales or nodules; inner ventral margin strongly crenate. Adductor muscle scar large, entirely posterior to midline, unstriated position relatively large. White, without periostracum. Byssus present. Tentacles short, ocelli small.

Notes: In its strongly asymmetrical form, flattened antero-dorsal margin and narrow, oblique resilium, this genus resembles *Acesta* H. & A. Adams, 1858, *Divarilima* Powell, 1958, and several of the extinct genera recognised by Cox & Hertlein (1969), notably the Triassic *Badiotella* Bittner, 1890. *Divarilima* and *Badiotella* differ from *Fukama* in their strongly opisthogyrate beaks; in addition, *Divarilima* is compressed with fine divaricate sculpture and no nodules on the hinge plate, *Badiotella* has a wider, outwardly sloping cardinal area with the lunule-like concavity smooth and

sunken into the hinge-plate itself. (Topotypic specimens of the type species of *Badiotella*, *B. schaurothiana* Bittner, 1895, from the Upper Triassic of St Cassian, South Tyrol, were kindly loaned to me by Dr Heinz A. Kollmann). *Acesta* contains very large, thin-shelled species from very deep water, with faint to fine sculpture, relatively shallow lunule, distinct anterior gape and a hinge nodule only on the anterior side. The nominal genus *Lima* Bruguière, 1797, differs from *Fukama* in its compressed valves, much higher than long, in its much more symmetrical hinge and cardinal area, broader, almost straight ligament, non-divergent umbones and lack of a lunule-like impression anteriorly.

Stuardo (1968: 85 on, unpublished) proposed a new subgenus of *Lima* Bruguière, 1797, for a group of species related to the Indonesian *Lima tomlini* Prashad, 1932 (and named it in MS). He tentatively included *Lima perfecta* E. A. Smith, 1904, and it would appear probable that his group is equivalent to the genus here proposed. As I have not examined the other species included by him (mainly from the tropical Indo-Pacific) I leave the question of the scope (and systematic rank) open.



Figs 50–51. *Fukama messura* sp. n., diagram of LV interior and dorsal view.

In *Fukama* the flattened antero-dorsal surface (and large lunule-like depression), together with the unusually tumid valves, are adaptations for a mytiloid way of life, the shell being secured tightly against flattened surfaces (rather than nestling in crevices like other Limidae) by the byssus. The deep valves may also be regarded as an adaptation for brooding, at least one (probably both) of the species retaining its larvae on the inner surface of the mantle (see below).

Etymology: *Fukama*: to incubate, Xhosa (the main indigenous language of Transkei), gender feminine.

**Fukama messura** sp. n.

Figs 50–53, 56, 58–59

**Diagnosis:** Radial ribs (excluding those in lunular depression) numbering 38–46, bearing thin, fluted, scale-like lamellae; umbonal ridge angular; inner end of lunule next to anterior ear forming a trigonal trough in each valve. Maximum height 11.6 mm.

**Description:** Valves tumid (d/h 0.54–0.84), obliquely ovate-trigonal (l/h 0.88–0.93), beaks slightly prosogyrate, inwardly directed, more or less posterior to middle, posterior and ventral margin strongly convex, antero-dorsal margin flattened to slightly concave, with a deep, wide lunule-like depression, bordered externally by an angular umbonal ridge, inner end of lunule with a deep trough (forming a chevron-shaped hollow in opposed valves); valves with only a very slight gape; posterior ear obtuse and weakly projecting, anterior one angular and contracted. Cardinal area wide and sloping outwards toward beaks, traversed by a narrow, oblique ligament (usually occupying less than one third of area), resilifer rendering ventral side of hinge line convex; hinge usually with a small tubercle at each end (sometimes weak or lacking), fitting into a depression in the opposing valve. Externally with strong, rounded but sharply incised radial ribs, 2–3 times width of their intervals, 31–37 on face of valve, 4–8 in lunular depression (becoming progressively weaker towards cardinal area), 6–9 on posterior face; ribs on valve face bearing thin, fluted, scale-like lamellae, their crests sometimes recurved but usually arching ventrally, wide enough to touch adjacent scales (or interlock with them), lunular ribs bearing small angular tubercles, those at posterior end more erect; external sculpture forming shallow radial grooves on valve interior; intervals between radial ribs with fine transverse striae; valve margins strongly crenulated. White.

**Dimensions:** Length 10.0 mm, height 10.9 mm, total depth 7.0 mm (holotype). Largest paratype valve: Length 10.2 mm, height 11.6 mm, valve depth 4.3 mm.

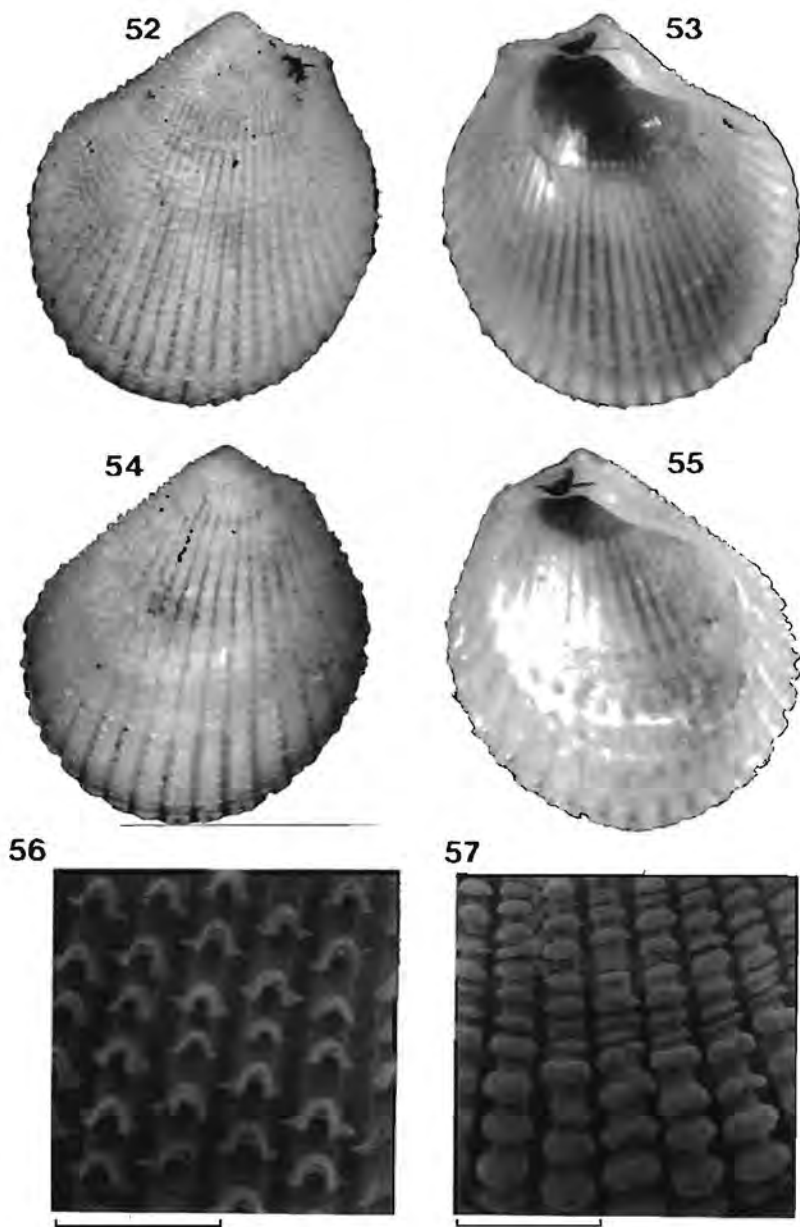
**Prodissoconch** smooth, length longer than height, dimensions 380 x 350 µm.

**Mantle ocelli** somewhat irregularly spaced, about 15–18 in number.

**Distribution:** Southern Natal to Eastern Transkei, 80–143 m, living mainly on siliceous sponges.

**Type material:** Holotype NMSA C467/T1188, off Mtamvuna River mouth (31°09.0'S; 30°15.3'E), 80 m, rocks.

**Paratypes:** **Southern Natal:** off Park Rynie, 110–130 m, eroded shell and conglomerate (B3595/T1524, 1); off Umzinto (Park Rynie), 84 m (E148/T1523, 1); off Port Edward, 120–125 m, sponges (D1354/T1532), 3 + 1RV, 2LV; same locality, 125 m, sponges (D900/T1536, 5 + 3RV). **Eastern Transkei:** off Mtamvuna River, 80 m, rocks (V77/T1189, 1); same locality, 140 m, sponge rubble (C891/T1530, 3 juvs); same locality, 143 m, sponge rubble (C912/T1528, 1 juv.); same locality, 120–140 m, sponge rubble (E68/T1526, 2); same locality, 120–140 m, sponge rubble (C445/T1531, 1 + 2LV); same locality, 110 m, some pebbles (C500/T1529, 1RV); same locality, 100 m, stone, rubble (C504/T1527, 3); between Mpahlana and Umyameni Rivers, 100 m, sponge rubble (C5393/T1522, 2); off Mzamba River,

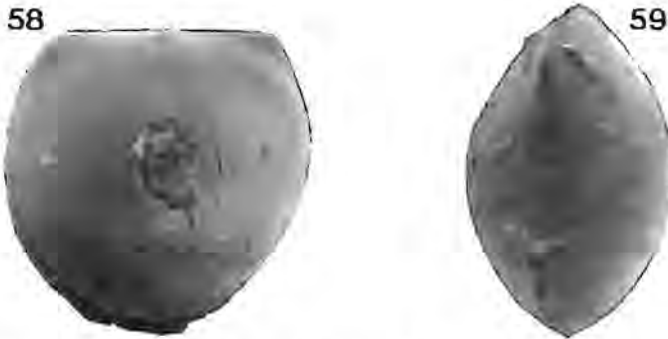


Figs 52–57. *Fukama* species. 52–53. *F. messura* sp. n. holotype, NMSA C467/T1188, off Mtamvuna River, 80 m, LV exterior and interior. 54–55. *F. perfecta* (E. A. Smith, 1904), NMSA C536, off Msikaba River, 150 m, 9.2 x 10.2 mm, LV exterior and interior. 56–57. Magnified sculpture. 56. *F. messura* (scale-bar = 1.8 mm). 57. *L. perfecta* (scale-bar = 1.2 mm).

100 m, sponge rubble (C5302/T1525, 3); off Port Grosvenor, 100–115 m, sand, some mud, solitary coral, shells (C1370/T1521, 2LV).

Notes: *Fukama messura* is extremely similar to *F. perfecta* (Smith, 1904), but is distinguished by its sculpture and details of the lunular depression (see diagnoses).

The right valve of one dried individual contained about 15 prodissoconchs (Figs 58–59), evidently brooded behind the inner edge of the mantle. None were present in the left valve, but it is likely that they were in the process of being released when the specimen was dredged.



Figs 58–59. Prodissoconchs of *Fukama messura* sp. n., 380 x 350  $\mu$ m, external and dorsal views.

Etymology: *messura* = a reaping, from 'river of reapers', which is the probable meaning of Mtamvuna (off which river most known examples were dredged).

*Fukama perfecta* (E. A. Smith, 1904), **comb. n.**

Figs 54–55, 57

*Lima perfecta* E. A. Smith, 1904: 43, pl. 3, fig. 29; Turton, 1932: 222; Barnard, 1964: 440, fig. 16c; Kilburn & Rippey, 1982: 169, textfig. 132, pl. 38, fig. 2. Type locality: Port Alfred.  
*Lima (Radula) perfecta*; Thiele, 1918: 18, pl. 3, figs 10–11.

Diagnosis: Radial ribs (excluding those in lunular depression) numbering 24–27, in places sometimes split by a median groove, bearing smooth, transverse nodules, slightly concave ventrally, equal to/slightly narrower than their intervals; umbonal ridge rounded; inner edge of lunule not deeply sunken. Maximum height 15.3 mm.

Description: Valves tumid (d/h 0.68–0.84), obliquely ovate-trigonal (l/h 0.85–0.96), beaks slightly prosogyrate, inwardly directed, more or less posterior to middle, posterior and ventral margins strongly convex, antero-dorsal margin flattened, with deep, wide, lunule-like depression, bordered by a rounded umbonal ridge; valves with slight crack-like gape anteriorly, barely developed posteriorly; posterior ear obtuse and weakly projecting, anterior one angular and contracted; cardinal area wide and sloping outwards toward beaks, traversed by a narrow, oblique ligament (usually occupying less than one third of total area), resilium rendering ventral side of hinge line convex; hinge usually with a small tubercle at each end (sometimes weak or lacking), fitting into a depression in the opposing valve. Externally with strong, rounded but sharply incised radial ribs, equal in width to twice width of their intervals, 19–22 on face of valve (sometimes bifid towards each end), 4–6 in lunular depression (visible more as rows of gemmules, evanescent at inner edge), 7–9 on

posterior face; ribs bearing transverse nodules, smooth and rounded dorsally, concave ventrally; external sculpture forming shallow radial grooves on valve interior; intervals between radial ribs with fine transverse striae; valve margins strongly crenulated. White.

Dimensions: Length 13.1 mm, height 14.3 mm, valve depth 5.1 mm (largest example).

Type material: 6 worn syntype valves in BMNH 19.3.12.19.995-1000.

Distribution: Southern Natal (off Park Rynie) to Eastern Cape (St Francis Bay), living in 87–150 m, on rocks and siliceous sponges; loose valves in beach-drift to 300 m.

Material examined (all NMSA: NMDP, dead, unless otherwise stated): **Southern Natal:** off Port Shepstone, 70 m, eroded shell and sponge (B3561, juv. valves). **Eastern Transkei:** off Mtamvuna River, 115 m, sponge, rocks, living (C488); same locality, 111 m, sponge (C842); same locality, 137 m, rocks, sponge, living (C848); off Msikaba River, 150 m, sponge rubble, living (C536); off Mpahlana River, 100 m, sponge rubble, living (C5254); off Rame Head, 70 m, mud, shell debris (C1929); off Kwanyana River, 100 m, sponge rubble, living (C5344); off Port Grosvenor, 100–210 m, coarse sand, some mud (C415); same locality, 120–128 m, same bottom (C1191); same locality, 150 m, sponge, coral (C349); same locality, 95–100 m, coarse sand, few gorgonians (C583); same locality, 82 m, worn calcareous (C683); same locality, 80 m, lithothamnion nodules and sheets (C943); same locality, 80–81 m, calcareous nodules (C933); off Mgazi River, 190 m, black mud (C8772); off Ubombo, 40–45 m, coarse sand, broken shell (C2454); same locality, 60–62 m, coarse sand, oyster shell conglomerate (C2488, E141). **Western Transkei:** off Bulungula River, 60 m, mixed fine sand and mud (C2500); off Mbashe River, 100 m, sponges, marine growth, little sand (C1963); same locality, 75 m, calcareous nodules (C1999); same locality, 100 m, live sponge (C9365); off Mendu Point, 48 m, fine sand (C4779); same locality, 66 m, coarse sand, rubble (C4808); same locality, 92–100 m, rocks, hydroids, broken coral (C4757); off Nqabara Point, 95 m, sponge, sand (C4178); off Qora River, 75 m, moderately fine sand (C3912); off Stony Point, 87 m, mainly coarse sand, living (C4285); same locality, 95 m, sponge rubble, living (C4219); off Mbizane River, 100 m, coarse sand, some sponge (B9037); off Qolora River, 96 m, gorgonians, sponges, living (C4654); same locality, 290–300 m, fine muddy sand, broken shell (C6982); off Kei River, 85 m, sponge rubble, coarse sand (C4964). **Eastern Cape** (NMSA, all beach-worn valves unless otherwise stated): off Cape Morgan Lighthouse, 100 m, broken coral, shell, dead (B1140); Nahoon River mouth, beach drift (A670: V. Stuart-Smith); East London, beach-drift (A1743: C. M. Connolly); Port Alfred, beach-drift (B696, B7004, 987, D4661, B6579, B7006: E. K. Jordan, W. H. Turton, R. Kilburn, J. Hutt); Jeffreys Bay (5192, B3132: R. Kilburn).

Notes: This species appears to live sympatrically with *F. messura*, and is similarly found byssally attached to rocks and sponges, mainly in about 50–100 m. Although most available specimens consist of loose valves, there is some indication that the species inhabits deeper water towards the eastern part of its range, perhaps indicating a preference for more temperate conditions. Thus living examples were dredged east of Ubombo Head only in 100–150 m, but west of Stony Point in 87–96 m, and on the

Eastern Cape beaches worn valves wash ashore, indicative of an even shallower habitat.

Although no sign of incubated young were found in either dried or wet specimens, the prodissoconch appears identical, suggesting a similar reproductive mode.

### *Ctenoides* Mørch, 1853

*Ctenoides* Mørch, 1853: 156. Type species (s.d. Stoliczka 1871): *Ostrea scabra* Born, 1778.

Of the three species here recorded, one is an Indo-Pacific incursive, the second may have a similar origin, and only the third (*Ctenoides symmetrica*) may prove to be a South East African endemic.

#### Key to South African species of *Ctenoides*

- 1 Radial ribs bearing prickly granules; anterior auricle thickened and arched, gape indistinct, outline oblong, constricted dorsally .....*annulata*
- Ribs smooth in adult; anterior auricle neither thickened nor arched, gape slight ..2
- 2 Ribs very fine, weakly divaricate, their intervals not distinctly pitted; outline almost symmetrical, typically almost orbicular, antero-dorsal margin not distinctly concave .....*symmetrica*
- Ribs coarser, distinctly divaricating medially, with pitted intervals; outline distinctly asymmetrical, never suborbicular, antero-dorsal margin concave .....*barnardi*

### *Ctenoides barnardi*, nom. nov.

Figs 60–62

*Lima divaricata* Barnard, 1964 (non Dujardin, 1837): 440, textfig. 16c. Type locality: Off O'Neil (Neill) Peak [Cunge], Zululand, 90 fath. [= 165 m].

*Lima divericata* [sic]; Giles & Gosliner, 1983: 45.

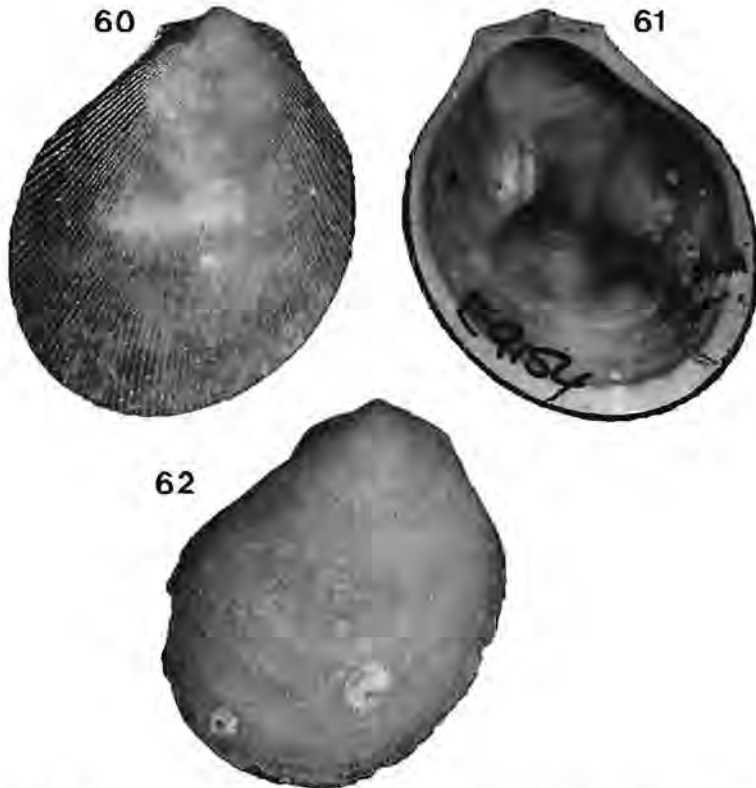
Type material: Two syntypes SAMC A9501, the fresher (Fig. 62) here designated as lectotype, dimensions 17.1 x 20.8 mm.

Distribution: Mid-continental shelf from Western Transkei (off Qolora River) to Northern Zululand (off Island Rock), in 85–140 m on sponge bottoms.

Locality data (all NMSA: NMDP, loose valves unless otherwise indicated):

**Northern Zululand:** off Island Rock, 100 m, sandstone rubble (E5316); off Gobey's Point, 55–100 m, sand, sponge rubble (D6667); off Gypsy Hill, 100–125 m, shell rubble (E3271, matching valves). **Southern Zululand:** SE of Port Durnford, 95 m, rocks and coarse sand (E8373, E8436), 100 m, rocks, sponge rubble (E8356), 85 m, sponges (D7905), 98–110 m, coarse sand (D8114), 230 m, mud and shell debris (E8541); off Matigulu River, 145 m, mud, shell rubble (E8806). **Northern Natal:** off Mvoti River, 70 m, mud (E9154). **Southern Natal:** off Park Rynie, 120 m, in crevice in sponge (B3983), 120 m, sponge rubble (B3925), 140 m, sand, sponge rubble (C1657), 110–130 m, sponge rubble (B3575, live juvenile), 136 m (B3875, live juvenile); off Trafalgar, 120 m, sand, sponge (B7252); off Mbizane River, 100 m, coarse sand, sponges (B9034). **Eastern Transkei:** off Mzamba River, 100 m, sponge rubble (C5303); between Mtamvuna and Mzamba Rivers, 100 m, sponges (C5443); Mgazi River, 190 m, black mud (C8773), 92 m, coarse sand and rubble (C2357); off

Port Grosvenor, 100–110 m, coarse sand, some mud (C427); off Kwanyana River, 100 m, sponge rubble (C5343). **Western Transkei:** off Stony Point, 95 m, sponge rubble (C4487); off Sandy Point, 90 m, calcareous debris (C4548); off Qolora River, 114 m, sponge rubble (C3936).



Figs 60–62. *Ctenoides barnardi* nom. nov. 60–61. NMSA E9154, off Mvoti River, 70 m, 17.1 x 20.8 mm, LV exterior and interior. 62. Lectotype, *Lima divaricata* Barnard, 1964 (non Dujardin, 1837), SAMC A93501, off Neill Peak, 165 m, LV, 12.9 x 15.1 mm.

Notes: Although known only from loose valves and paired juveniles, many specimens dredged during the NMDP retain the periostracum. The incidence of such fresh specimens is closely correlated with a substratum of sponge communities, and one complete juvenile was actually found in a crevice inside a siliceous sponge. Almost all available Transkei examples are worn and discoloured, but an example from Sandy Point retains traces of ligament and periostracum, confirming its living presence that far west.

Renamed in honour of its describer, Keppel Harcourt Barnard (1887–1964). In this I was anticipated by Stuardo (1968: 118, unpublished), although both names are freely used in his MS. The species may prove to have a wide tropical distribution, as Stuardo noted 'Three additional samples from the Philippines and off Pratas Id., China Sea seem inseparable'.



*Ctenoides symmetrica* (Barnard, 1964), **comb. n.**

Figs 64–67

*Lima symmetrica* Barnard, 1964: 441; *idem* 1969: textfig. 29e; Giles & Gosliner, 1983: 45. Type locality: off Cape Vidal, Zululand, 60–100 fath. [= 110–183 m].

Type material: Holotype SAMC A9503 (Fig. 64).

Distribution: Eastern Transkei (Port Grosvenor) to Northern Zululand (Gobey's Point), in about 150–250 m. See also below.

Additional locality data: **Northern Zululand:** off Gobey's Point, 120–150 m, sandstone rubble, glass sponges (D7589, live juv.). **Southern Zululand:** off Leven Point, 250 m, coarse sand (S9280, juv.), 170 m, sandstone rubble, shell rubble (E3707); off Matigulu River mouth, 200–220 m, mud, coarse sand (E8970). **Eastern Transkei:** off Port Grosvenor, 120–128 m, coarse sand, some mud, solitary corals (C1152)

Notes: This species grows larger than the holotype (e.g. height 16.4 mm, length 14.4 mm; height 16.7 mm, length 13.3 mm), but no fresh adult valves are yet known. Live-taken juveniles show only a thin yellowish periostracal film; in these the ribs are cut transversely so that they present a glittering, finely segmented appearance. There is some variation in proportions (l/h 0.80–0.88), but even the narrowest examples are always distinguishable from *C. barnardi* by their much finer ribbing.

The similarly shaped tropical species *Ctenoides philippinarum* Masahito & Habe, 1978, has much coarser radial ribs which bear rasp-like granules (topotype from Bohol, Philippines, NMSA K3437).

*Ctenoides annulata* (Lamarck, 1819)

Fig. 63

*Lima annulata* Lamarck, 1819: 157. Type locality: 'Ile de France' [Mauritius].

*Lima (Ctenoides) annulata*; Lamy 1930: 193 (references and synonymy).

*Lima (Lima) annulata*; Prashad, 1932: 122 (references and synonymy).

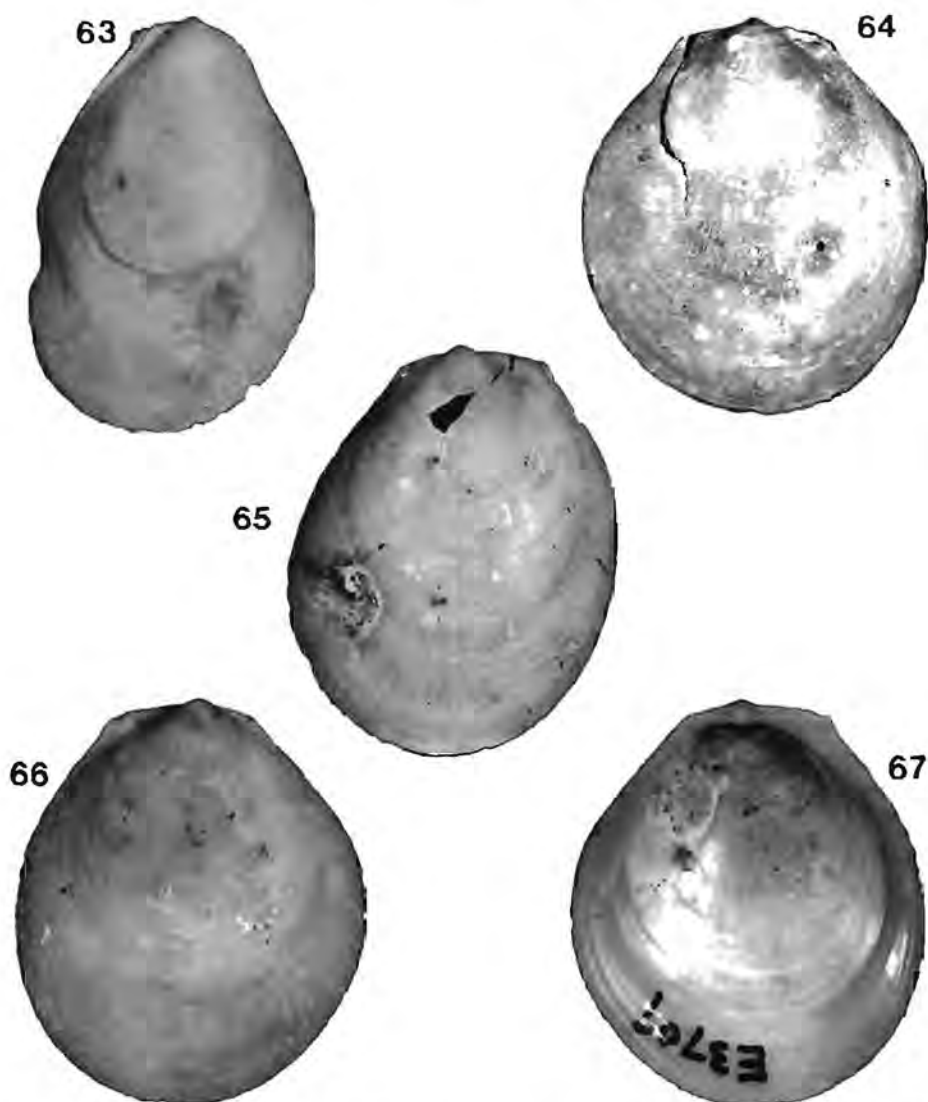
*Ctenoides annulata*; Willan, 1973: 17, fig. 4; Lamprell & Whitehead, 1992: pl. 16, fig. 94; Oliver, 1992: 83, textfigs. 2a–b, pl. 14, figs 8a–b.

Type material: Syntype in MNHP (Lamy 1930). Although this syntype was ostensibly figured by Stuardo (1968: pl. 2, figs 22–23), his photographs appear to show *Ctenoides concentrica* (Sowerby, 1888), and this is presumably a *laps. cal.*

Distribution: Japan and Red Sea to northern Zululand (*ca.* 28°07'S), coral reef habitats, single valves locally in 70–200 m.

Regional locality data (all NMSA: NMDP, loose valves): **Northern Zululand:** off Dog Point, 200 m, fine sand (D7771), same locality, 100 m, fine sand (D7652); off Rocktail Bay, 100 m, sandstone rubble (D7620); off Gobey's Point, 120–150 m, sandstone rubble (V5907); off Gipsey Hill, 65–70 m, broken shell rubble (E3652); off Cape Vidal, 145 m, medium sand (E4972).

Notes: Zululand valves agree well with NMSA topotypes collected during the Natal Museum Mauritius Expedition (K4199, between Mahebourg and Point Desnay, in live *Acropora*-type coral; K8996, Tombeau Bay, beach drift; K9599, Point Radeau,



Figs 63–67. *Ctenoides annulata* (Lamarck, 1819) and *C. symmetrica* (Barnard, 1964). 63. *C. annulata*, NMSA V5907, off Gobey's Point, 120–150 m, RV exterior, 12.7 x 18.7 mm. 64–67. *C. symmetrica*. 64. Holotype, *Lima symmetrica*, SAMC A9503, off Cape Vidal, 110–183 m, 13.7 x 15.1 mm. 65. NMSA C1152, off Port Grosvenor, Transkei, 120–128 m, RV exterior, 13.3 x 16.7 mm. 66–67. Off Leven Point, Zululand, 170 m, RV exterior and interior respectively, 14.4 x 16.4 mm.

beach drift), and with other Mascarene material (NMSA K8644, Anse aux Anglais, Rodrigues Is.; K5716, Cap la Houssaye, Réunion Is., 12 m, J. Drivas), also L2456, Watson's Bay, Queensland, 20 m, T. Whitehead. Although Willan (1973) reported considerable variation in shape in a Vanuatu population, South African material is quite constant in the teardrop-shaped outline of the valves. All local specimens consist of single valves, which are mainly worn or juvenile.

## ACKNOWLEDGEMENTS

This study was partly supported by grants from the Foundation for Research Development. Most of the material studied was collected during the Natal Museum Dredging Programme (1980–1993), and subsequently through collaboration with the Sea Fisheries Research Institute. For the loan of types and other material I am indebted to Ms Kathie Way (BMNH), Dr Serge Gofas (MNHP) and Ms Michelle van der Merwe and Ms Liz Hoensen (SAMC). Dr Rudolf Kilias gave access to the *Valdivia* types during my visit in 1992. For photocopies and information I am indebted to Drs Rüdiger Bieler, Bruce Marshall, Serge Gofas, Anders Warén, Paula Mikkelsen and Tomowo Ozawa. Mrs Linda Davis helped in the preparation of plates. I thank the Electron Microscopy Unit of the University of Natal, Pietermaritzburg, for the use of their equipment. Rüdiger Bieler, Bruce Marshall, Serge Gofas and Dai Herbert kindly commented on the manuscript.

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